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ROYAL BOTANIC GARDENS, KEW.

BULLETIN

OF

MISCELLANEOUS INFORMATION.

No. 10] [1920

LII.—A WILT OF CARNATIONS, NIGELLA, DELPHINIUM AND COSMOS, WITH A NOTE ON SCLEROTIUM ROLFSII.

W. Small.

In May, 1919, carnation plants in a garden near Kampala, Uganda, were observed to be dying by stages. The plants wilted gradually, paling of the lower leaves being succeeded by the collapse of the whole plant. The outer tissues of the underground parts of the stems of affected plants separated readily from the wood, and an easy pull from the ground broke off the plants. This disintegration of the tissues just under the soil surface was marked by a blackened sunken soft area, longitudinally arranged, and evidently a characteristic symptom of the disease. It was found to be of regular occurrence.

Histological examination of the wood immediately under the discoloured area, which was invariably stained a dark colour, showed it to be permeated with mycelium. This internal mycelium varied in thickness, was much branched, and was seen to pass freely from tracheids to parenchyma without constrictions. The main hyphae in a tracheid would give off numerous slender branches which could be followed as they penetrated the pits. In only one dead plant a second mycelium, which will be referred to later, was found between wood and bast. It was remarkable for the numbers of crystals occurring along its course. This second mycelium was found also externally on the diseased crown of the plant, and, in this position, it was accompanied by sclerotia as well as by crystals, and determined as *Sclerotium Rolfsii*, Sacc.

On the dead leaves of wilted plants were found a species of *Periconia* and a *Macrosporium* which resembled *M. nobile*, Vize, figured by Massee on p. 504 of his "Diseases of Cultivated Plants

(1222.) Wt. 135—P. 47. 1,000. 12/20. J. T. & S., Ltd. G. 14. Sch. 12.

and Trees" (1910). It may be significant, in view of what follows, that Massee's set of figures of the *Macrosporium* includes a drawing of three *Fusarium* spores found, according to the text, "mixed with, but no proof of relationship with, the *Macrosporium*." As far as can be judged from the figure, these *Fusarium* spores resemble those subsequently referred to in this paper, and also those figured by Dr. Van der Bijl in his account of a South African wilt of carnations.* The Uganda wilt under discussion is undoubtedly similar in all respects to that described by Van der Bijl, and it is unnecessary, in view of the previous publication of his paper, to go into full details.

ISOLATION OF THE FUNGUS.

In attempts to show whether the Uganda wilt was the same as that of South Africa or to discover another cause for it, if such existed, small pieces of tissue were cut with sterile instruments from the underground diseased areas of wilted carnations, already described, and, after sterilisation in mercuric chloride (1 : 1000) or flaming in alcohol, were shaken up in tubes of solid media and poured into petri-dishes. The solid media consisted of $2\frac{1}{2}$ per cent. carnation-, prune-, or sugar-cane-agar.

Mycelial growth took place at laboratory temperature after the lapse of twelve hours, and microconidial formation was very vigorous after three days. After fourteen days the conidia were three-, and, later, multi-septate and of a *Fusarium* type. Chlamydospores were produced in abundance both terminally and intercalarly. The aerial mycelium, at first faintly pink in the mass, became after twelve days of a deep pink colour.

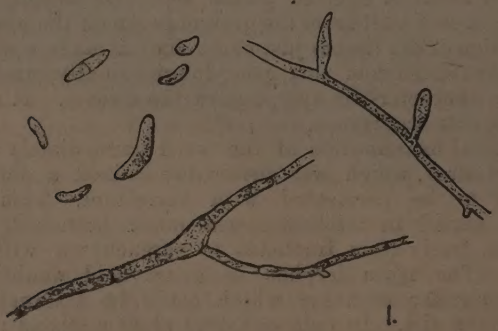


FIG. 1.—Mycelium, conidia and conidiophores of *Fusarium* sp. from Carnation, in pure culture, 36 hours, × 500.

Subcultures were subsequently made on banana plugs and prune-agar slants, and the latter were used in inoculation experiments. The colour of the banana-plug mycelium was at first

* Van der Bijl: "Wilt" or "Crown Rot" Disease of Carnations caused by *Fusarium* sp.—Annals Appd. Biology, II., 267, 1915–16.

faintly grey, and afterwards pink, while that of the prune-agar mycelium was a very faint yellow succeeded by a pink. Chlamydospores appeared in these cultures in six days. The fungus was also grown from microconidia placed in sterile distilled water. In this case the mycelium assumed a rosy-pink colour which became almost dark-red. It was many-septate, globuled and apparently brittle, and numerous conidia and chlamydospores were developed.

At the same time whole diseased carnation plants were carefully sterilised and afterwards placed in damp chambers; these were found to develop upon and in the neighbourhood of the sunken area of the crown aerial mycelium of a white-pink colour accompanied by conidia after the lapse of twelve days. This mycelium and the conidia were indistinguishable from those obtained from the cultures mentioned above, and from those found in further cultures derived from them by transferring mycelium and conidia directly into tubes and plates.

ISOLATION OF THE FUNGUS FROM WILTED NIGELLA AND DELPHINIUM.

A few days after the receipt of the wilted carnation material, dying plants of love-in-a-mist (*Nigella*) and larkspur (*Delphinium*) were found in the same bed of the same garden which afforded the examples of carnation wilt, and, after a further few days, a dying plant of *Cosmos* (*bipinnatus?*) was similarly collected.

All these were found to show the same macro-symptoms as the wilted carnations, and, histologically, to be attacked and permeated in the same parts by mycelium similar to that found in the carnation material. On the exterior of two of the *Delphinium* tap-roots were found mycelium, conidia, and chlamydospores which were shown to be identical with material of cultures derived from the *Delphinium* plants. No mycelium or sclerotia of *Sclerotium Rolfsii* were found on either the *Nigella*, *Delphinium* or *Cosmos* material.

Whole plants of *Nigella* and *Delphinium* were sterilised by immersion for ten minutes in mercuric chloride solution (1 : 1000), and small pieces of tissue from the blackened areas near the crowns were cut out under sterile conditions and placed in prune-agar plates. The remains of the plants were put into damp-chambers. In all of these, both *Nigella* and *Delphinium* plants, plentiful mycelial growth occurred on collars and tap-roots after the lapse of thirty-six hours, and after a further twelve hours *Fusarium* microconidia were in abundance. The conidia were one- or three-septate and varied in length form 10 to 20 μ, the more elongated being comparatively narrower than the shorter forms. The mycelium was white and flocculent. Sets of banana-plugs were subsequently inoculated with microconidia from both host plants. Growth was comparatively slow, for no aerial mycelium was visible until three days had elapsed and no conidia were found until twelve days later. These conidia were small, and successive crops of them did not attain the size of those used to inoculate the banana plugs until after twenty-four days. The

mycelium in both sets of cultures was latterly of a dark-grey colour with a faint pink tinge in parts.

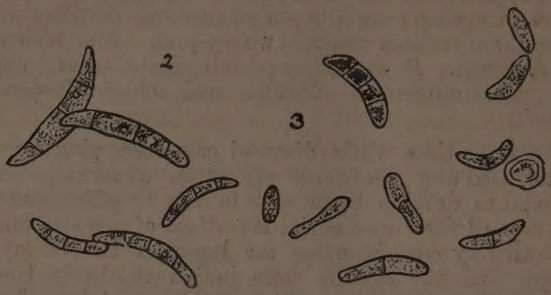


FIG. 2.—Conidia from pure culture of *Fusarium* sp. from *Nigella*, × 500.
FIG. 3.—Microconidia and a chlamydospore from same culture as 2, × 500.

The tissue fragments of both *Nigella* and *Delphinium* in prune-agar gave rise overnight to aerial mycelium which was white, flocculent, septate, branched, finely-granular, and of an average thickness of 5 μ. Growth continued vigorously, and after four days microconidia were very numerous. These were succeeded by macroconidia and chlamydospores after a further twenty-four hours.

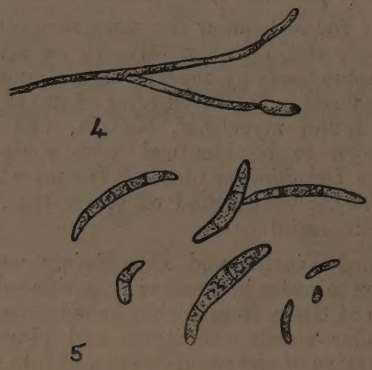


FIG. 4.—Formation of terminal conidia in same culture as 2 and 3, × 500.
FIG. 5.—Conidia of *Fusarium* sp. from *Delphinium*, × 500.

The *Cosmos* material was rather scanty, and it was unfortunately impossible to isolate from it pure strains of the fungus at work. But it should be noted that a *Fusarium* was found externally upon it, and that the conidia and chlamydospores of this *Fusarium* were identical with those found on the *Nigella* and *Delphinium* material. It could not but be observed that there was a striking resemblance between the species of *Fusarium* isolated from the carnation, *Nigella* and *Delphinium* plants, and there seemed to be good ground for the conclusion that the fungus at work was the same in all three cases. As it was desirable to study more closely than had been done the differences between

the strains from the different hosts, further cultures were made by inoculating sugar-cane-agar slants with conidia derived in each case from the original tissue fragments in petri-dishes. These cultures were kept under exactly similar conditions.

Mycelial growth was visible in all in forty-eight hours, and after seventy-two hours the surfaces of all the slants were covered with flocculent mycelium bearing numerous microconidia. The then prevailing colour of the carnation culture mycelium was white to pale-yellow; of the *Nigella*, honey-yellow, and of the *Delphinium*, faint pink. After six days the *Nigella* and *Delphinium* cultures showed numerous conidia measuring up to 40 by 7 μ and becoming three- to five- and multi-septate. Chlamydospore-formation took place in all three strains on the seventh day. It was remarked that the *Nigella* and *Delphinium* strains of the *Fusarium* were alike in respect of the time-development of conidia though not in respect of the numbers of conidia. The carnation strain, again, lagged behind in the production of macroconidia, but its microconidia were always far more plentiful than those of the other strains. After sixteen days the carnation slants were producing very numerous microconidia and only a few macroconidia. The latter measured up to 30 by 3 μ, and were commonly only three-septate. They were thus smaller than the same conidia of the other strains. The many-septate condition was fairly scarce, and the chlamydospores measured up to 8 μ in diameter.

Of the three strains when judged from the standpoint of the vigour of conidial production and the sizes of the mature conidia at equal ages, that derived from the *Nigella* material was the most vigorous, and that from the carnation material the least so. Judged by the same standards, the fungus from the *Delphinium* material tended towards an intermediate position between the *Nigella* and carnation strains. In other words, the physiological expressions of the three strains varied slightly, and this variation was accompanied by slight morphological differences. As a consequence, the results of the cross-inoculation experiments which were instituted were anticipated with interest.

INFECTION EXPERIMENTS.

Series of plants were grown in large tins in soil which had been treated in the autoclave at 115° C. for an hour. Imported seeds and cuttings from wilt-free plants were used, and control pots were kept in each case. The inoculum employed consisted of small pieces of agar with conidia and mycelium of the fungus, and the viability of the mycelium and spores was tested in hanging-drops of sterile distilled water.

The first series of experiments consisted of the direct inoculation of the *Fusarium* from carnation, *Nigella* and *Delphinium* cultures into the soil of tins containing respectively carnation, *Nigella* and *Delphinium* plants. The inoculum was treated in two ways (1) by being placed from $\frac{1}{2}$ in. to 1 in. below the surface of the soil in close proximity to the growing plants, and (2) by being placed against wounds made in the plants by cutting or scratching with a sterile scalpel from $\frac{1}{2}$ in.

to 1 in. below the soil surface. After the inoculations and wounding of the control plants when necessary, all the tins were kept in one place out of doors. During the ensuing period when the plants were under observation, the rainfall amounted to 6·79 in. distributed very evenly over forty days.

The *Nigella* plants, both wounded and unwounded, were the first to show signs of disease; the typical sickly appearance was noticed after six days. Complete collapse of the first diseased plants took place after twenty days. Meanwhile, the carnations and *Delphiniums* began to wilt, the periods between first signs of disease and death ranging from fifteen to eighteen days. All the inoculated plants of all three species were dead in thirty days. No difference could be detected between the behaviour of wounded and that of unwounded plants. Removal of dead plants from the soil disclosed the usual softened area, and the *Fusarium* sp. was isolated (by the tissue-fragment method) from all except one carnation plant. All the controls remained healthy.

While these experiments were in progress a series of cross-inoculations was undertaken. Sets of six tins each of plants of carnations, *Nigella* and *Delphinium*, were inoculated in the two ways already mentioned, each set of three with material from cultures from all three host-plants. In this way carnations were inoculated with the fungus from carnation, *Nigella* and *Delphinium; Nigella* plants were inoculated with the fungus from *Nigella*, *Delphinium* and carnation; and *Delphinium* with the fungus from *Delphinium*, carnation and *Nigella*. The plants in all the tins were slightly thinned out, a clear line was made across the middle of each tin, and the plants of one-half were set aside as controls. At the same time, six lots of *Cosmos* plants were treated similarly and inoculated with the *Fusarium* from carnation, *Nigella* and *Delphinium*.

The results of these cross-inoculation experiments were remarkably consistent. All the sets of inoculated plants, including those of *Cosmos*, contracted the wilt disease and succumbed to it; the time elapsing between the observation of first signs of sickness and death varied from nineteen to thirty-one days. Again, no difference was noted between wounded and unwounded plants, and again the *Fusarium* sp. was recovered from wilted plants by the tissue-fragment method. It could not be said that there were any really distinct signs of greater pathogenicity in one strain than in the others, though such signs were looked for, but on the other hand, it seemed clear in a few cases that the recovered *Fusarium* was of the *Nigella* or *Delphinium* type rather than the carnation type, or vice-versa. For example, certain plants of *Nigella* inoculated with the carnation strain gave, on recovery of the fungus, the distinct carnation type of *Fusarium* with the very numerous microconidia and the slowly-developing macroconidia, and several plants of *Cosmos* inoculated with the *Nigella* strain gave, in the same way, the *Nigella* type with its early-maturing large-sized macroconidia. Unfortunately, pressure of routine and other work prevented this point from being followed up, as it also prevented the question of combating the *Fusarium* with soil

fungicides from being undertaken. It seems clear, however, that, whatever morphological and physiological differences may exist between the different strains, the results of the cross-inoculation experiments lend themselves to the one interpretation, viz., that the species of *Fusarium* under investigation is the cause of a wilt of carnations, *Nigella*, *Delphinium* and *Cosmos*.

The control plants of the cross-inoculation experiments were kept under observation for some time, and it was noted that the majority remained healthy for a further period of four months. Several of the carnation plants adopted a rosette-like habit of growth, but it was not determined if this was due to the *Fusarium*.

Control measures.

Neither quicklime nor formalin was available and could not be tried. The bed which originally yielded the examples of wilted carnations, *Delphinium*, *Nigella* and *Cosmos* was treated with a solution of carbolic acid (1 oz. to 1 gallon of water), at the rate of 1 gallon of solution to every four or five square feet. The treatment was not successful, for replanted carnations, etc., were attacked and killed by the *Fusarium*. Subsequently, a proprietary soil-fungicide (Fungal) was dug into the diseased soil in small quantities, roughly at the rate of two or three ounces to a cubic foot of soil. Results are not available, but it is felt that an extended use of Fungal might prove successful. Again, the addition of a drop of 10 per cent. Izal to 25 c.c. of solid medium prevented growth of the *Fusarium* in culture. This disinfectant, therefore, might be usefully employed, but, as has been indicated, it was not possible at the time to experiment fully. A satisfactory method of freeing soil from parasitic fungi with a material at once cheap and easily handled has yet to be discovered, and it is now generally recognised that help may be profitably sought oftener along the lines of selection and breeding of resistant or immune varieties than along those which lead to the use of chemical fungicides.

Note on *Sclerotium Rolfsii*, Sacc.

The occurrence of mycelium and sclerotia of *Sclerotium Rolfsii*, Sacc. on a single wilted carnation plant has already been noted. The mycelium was white in colour and the crystals associated with it were found to dissolve in strong hydrochloric acid. Further investigation showed it to have penetrated the woody tissues of its host along with *Fusarium* mycelium, but it was always distinguishable from the latter by the presence of the crystals which are presumably characteristic of *Sclerotium Rolfsii*.

Pure cultures of this fungus were easily prepared by transferring sclerotia to decoctions of sugar-cane in petri-dishes. Mycelial growth and the formation of sclerotia were very rapid, the whole dish becoming within a few days a strong felted mass of hyphae dotted with sclerotia in various stages of development. The sclerotia in culture and in nature are more or less spherical, but may be ovoid; they change colour during growth from pale to dark-brown, and they resemble mustard seed in size. The

mycelium of the cultures was aerial, white, flocculent, septate, with numerous crystals, and, in arising from a sclerotium, it "flowed," as it were, in aggregated and twisted strings which originated at definite points.

In sclerotial-formation, masses of hyphae stand erect from the substratum of mycelium. They are dumb-bell-shaped in the earliest stages. Gradually, the free end of the mass rounds itself off, becomes more compact, and changes colour from an intense white to a pale brown. When it is fully mature, the sclerotium is easily detached. The point of attachment is often marked by a dimple, and it may be darker in colour than the body of the sclerotium. During growth the sclerotia are covered with droplets of moisture. Occasionally the hyphal mass will form a twin sclerotium which is then dumb-bell-shaped. The core of a sclerotium consists of a densely-woven mass of hyphae, while the covering strands forming the exterior are arranged in one direction. The latter may be slightly ragged, but the sclerotium is, as a rule, perfectly smooth. In one culture which was contaminated with a green mould, the growth of mycelium was sufficiently profuse and rapid to smother and eventually to overwhelm the mould.

In sterile distilled water the growth of mycelium from a sclerotium was very sparse, and no new sclerotia were formed in the space of three months. Similarly, sclerotia placed in sterilised soil moistened with sterile distilled water gave rise to mycelia which were comparatively weak in amount, but strong enough in growth to attach themselves to small stones. Growth, however, ceased altogether in twenty days. Young pale-brown sclerotia could not be induced to push out mycelial strands. No conidial stage was found in any of the cultures.

A few infection experiments were conducted with *Sclerotium Rolfsii* by placing sclerotia and mycelia from a culture amongst soil in which were growing carnations, *Nigella*, *Delphinium* and *Cosmos*. No results were apparent, although the plants were kept for several months. Subsequent exhumation of the sclerotia proved that no mycelial growths had taken place. The fungus may have occurred as a saprophyte only, and its scarcity may have been accounted for by its lack of means of dissemination; but, again, a soil-moisture stimulus was evidently not sufficient to provoke development, and the infection sclerotia were not placed in contact with the plants. Mature sclerotia placed in small quantities of prune decoction in watch-glasses, usually filled the watch-glasses with a growth of mycelium in twenty-four hours, but similar sclerotia when treated first by immersion in a solution of Izal (1 : 100) or carbolic acid (1 oz. to 1 gall. water), for five minutes, and afterwards placed in prune decoction, showed no growth at all. The effect of Fungal, tested by immersing sclerotia for twelve hours in open jars of soil containing the fungicide, was similar, viz., total inhibition of growth.

This record of *Sclerotium Rolfsii* is the only one for Uganda, and no allied form has yet been found on any other plant.

LIII.—DIAGNOSES AFRICANAE: LXXIV.

1651. **Bolusia rhodesiana,** *Corbishley* [Papilionaceae-Galegeae]; affinis *B. amboensi*, Harms (*Phaseolo amboensi*, Schinz), sed innovationibus leviter pubescentibus, foliolis plerumque angustioribus longioribusque, petiolulis basi conspicue pubescentibus, calycis lobis (praesertim fructiferis) multo longioribus differt.

Herba perennis, e basi ramosa, 0·3–0·75 m. longa, leviter pubescens, lignosa. *Folia* digitatim 3-foliolata, linearia, glanduloso-punctata, foliolis basi cuneatis sessilibus apice minute mucronulatis ad 2·5 cm. longis, 0·5–1 cm. latis, lateralibus multo brevioribus, costa infra pubescente; petioli usque ad 1 cm. longi, adpresse pilosi; stipulae foliaceae, oblique cordatae, erectae, glanduloso-punctatae, 7 mm. longae, 5 mm. latae. *Flores* pauci; rachis terminalis vel folio opposita; pedicelli leviter pilosi, 5 mm. longi; bracteae circiter 4 mm. longae, ciliatae, bracteolis brevioribus linearibus. *Calyx* 0·8–1 cm. longus, lobis patentibus circiter 0·6 cm. longis. *Vexillum* glabrum, striatum; alae circiter 8 mm. longae; carina spiraliter contorta, resoluta usque ad 5 cm. longa, nitido-aurea. *Genitalia* inclusa, contorta. *Legumen* turgidum, 3 cm. longum, rostratum, glabrum. *Semina* multa, immatura reniformia, compressa, 3 mm. lata, funiculo 1·5 mm. longo.

Tropical Africa. Southern Rhodesia, without definite locality (probably Rusape), *Hislop* 26.

1652. **Mairea feliciodes**, *Hutchinson et Corbishley* [Compositae-Asteroideae]; affinis *M. lasiocarpae*, DC., sed foliis oppositis multo latioribus (nec subteretibus), capitulis majoribus, achaeniis breviter pubescentibus differt.

Suffrutex ramosus; rami vetustiores teretes, cinerascentes, circiter 3 mm. diametro; ramuli hornotini laxe foliati, adpresse strigoso-pilosi. *Folia* opposita, sessilia, oblongo-lanceolata, basi attenuata, apice subobtusa et recurvata, usque ad 2 cm. longa, 3–5 mm. lata, coriacea, setoso-pilosa. *Capitula* terminalia, longe pedunculata, usque ad 5 cm. expansa; pedunculus nudus, breviter pubescens, circiter 7 cm. longus. *Involucri bracteae* subuniseriatae, oblongo-lanceolatae, acutae, 8–9 mm. longae, extra strigosae, intra nitidae, marginibus membranaceis. *Flores radii* numerosi; corollae tubus angustus, 3 mm. longus, minute puberulus; lamina circiter 2 cm. longa, apice minute trifida; styli rami filiformes, 3 mm. longi. *Flores disci:* corollae tubus basi constrictus, 7 mm. longus, basin versus leviter puberulus; lobi anguste triangulares, acuti. *Achaenia* compressa, elliptica, 2·5 mm. longa, breviter pubescentia. *Pappi* setae corollae tubo longiores, plumosae, pallide stramineae.

South Africa. Griqualand West: Asbestos Mts., 1200 m., July 1894, *R. Marloth* 2018 (type); Colesberg, near the Orange River, *W. Knobel* (without number).

A very distinct species on account of the opposite leaves, which are exceptional in the genus.

1653. **Mimusops Macaulayae,** *Hutchinson et Corbishley* [Sapotaceae-Mimusopeae]; affinis *M. umbraculigerae*, nobis,

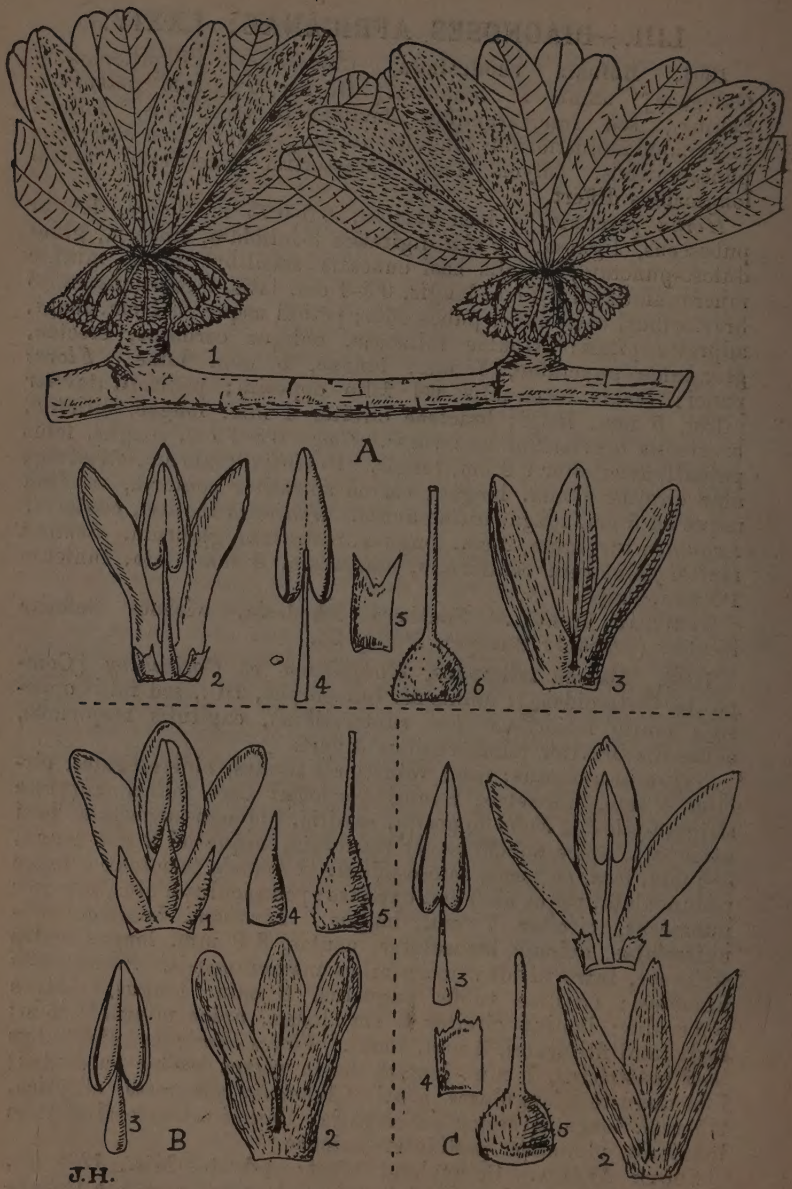


FIG. A.—*Mimusops Macaulayae*, nobis:—1, flowering branch; 2, corolla segment and its two lateral appendages and stamen from within; 3, the same from outside; 4, stamen from outside; 5, staminode; 6, pistil. B.—*Mimusops spiculosa*, nobis:—1, corolla segment and its two lateral appendages and stamen from within; 2, the same from outside; 3, stamen from outside; 4, staminode; 5, pistil. C.—*Mimusops umbraculigera*, nobis:—1, corolla segment and its two lateral appendages from within; 2, the same from outside; 3, stamen from outside; 4, staminode; 5, pistil:—A1 slightly reduced; remainder enlarged.

sed foliis infra lanato-pubescentibus, pedicellis longioribus, petalis apice integris, staminodiis profunde bilobis differt.

Ramuli biformes, elongati, efoliati, abbreviati brevissimi, apice dense foliati et floriferi. *Folia* oblongo-elliptica, apice emarginata, basi obtusa, 2·5–4 cm. longa, 1·3–2 cm. lata, coriacea, supra laxe pubescentia, infra lanato-tomentosa, nervis lateralibus inconspicuis; petioli 5–6 mm. longi, tomentosi. *Flores* infra folia dense aggregati, pedicellis ex axillis foliorum delapsorum ortis recurvatis circiter 8 mm. longis tomentosis. *Sepala* videntur 3 + 3, ovato-elliptica, circiter 4 mm. longa et 2 mm. lata, exteriora pubescentia. *Corollae segmenta* sepalis isomera, oblongo-lanceolata, apice obtusa, marginibus undulatis, 3 mm. longa, 1 mm. lata, appendicibus lateralibus oblongis fere aequilongis. *Stamina* petalis isomera et opposita; filamenta filiformia, circiter 2 mm. longa; antherae 2·5 mm. longae; staminodia plana, oblonga, apice profunde biloba, lobis triangularibus vel linearibus. *Pistillum* 4 mm. longum, ovario ovoideo-globoso breviter pubescente in stylum glabrum lineare abrupte contracto.

Tropical Africa. Northern Rhodesia, Mumbwa, *Mrs. Macaulay* 1002.

1654. **Mimusops spiculosa**, *Hutchinson et Corbishley* [Sapotaceae-Mimusopeae]; affinis *M. Mochisia*, Baker, sed foliis pubescentibus minoribus, pedicellis et antheris brevioribus, staminodiis filamenta similibus differt.

Frutex divaricatus, ramulis biformibus rugosis glabris. *Folia* ad apices ramulorum brevissimorum dense aggregata, oblanceolata, apice emarginata, basi breviter angustata, immatura 2–3 cm. longa, 0·8–1·2 cm. lata, tenuiter chartacea, discoloria, utrinque lanato-pilosa, nervis lateralibus inconspicuis; petioli circiter 4 mm. longi, tomentosi. *Flores* infra folia dense aggregati, pedicellis ex axillis foliorum delapsorum ortis recurvatis circiter 6 mm. longis adpresse pubescentibus. *Sepala* 3 + 3 vel 4 + 4, ovato-elliptica, circiter 4 mm. longa et 2 mm. lata, extra pubescentia. *Corollae segmenta* sepalis isomera, oblongo-elliptica, integra, apice rotundata, 3 mm. longa, 1 mm. lata, appendicibus lateralibus 2 paullo minoribus. *Stamina* petalis isomera et opposita; filamenta spiculiformia, 1·5 mm. longa; antherae crassae, 2 mm. longae; staminodia filamentis similia sed paullo breviora. *Pistillum* 3 mm. longum, ovario pubescente in stylum glabrum sensim attenuato.

Tropical Africa. Rhodesia: Victoria Falls; spreading shrub on cliffs round Gorge, November 1905, *C. E. F. Allen* 185.

1655. **Mimusops umbraculigera**, *Hutchinson et Corbishley* [Sapotaceae-Mimusopeae]; affinis *M. densiflorae*, Engl., sed foliis utrinque pubescentibus, staminodiis irregulariter dentatis differt.

Ramuli subverticillati, cortice verruculoso cinereo obtecti, infra apicem circiter 7 mm. diametro. *Folia* ad apices ramulorum dense aggregata, oblanceolata, apice rotundata et emarginata, basi attenuata, 3–5 cm. longa, 1–1·7 cm. lata, juniora tenuiter chartacea, discoloria, supra fere glabra, infra molliter

pubescentia, nervis lateralibus utrinsecus circiter 12, a costa sub angulo recto abeuntes; petioli 4–5 mm. longi, pubescentes. *Flores* infra folia dense aggregati, pedicellis ex axillis foliorum delapsorum ortis recurvatis circiter 5 mm. longis pubescentibus. *Sepala* 3 + 3 vel 4 + 4 rare 5, ovata, 3·5 mm. longa, 1·5 mm. lata, praecipue exteriora extra pubescentia. *Corollae segmenta* sepalis isomera, oblongo-lanceolata, apice leviter denticulata, circiter 3·5 mm. longa, appendicibus lateralibus 2 paullo brevioribus. *Stamina* petalis isomera, opposita; filamenta ultra 2 mm. longa, a basi latiore linearia; antherae 1·5 mm. longae; staminodia oblonga, apice irregulariter dentata, vix 1 mm. longa. *Pistillum* 3·25 mm. longum, ovario breviter pubescente, stylo longiore glabro.

Tropical Africa. Southern Rhodesia: without definite locality or collector, *Herb. Dept. of Agric. S. Rhodesia* 2639.

1656. **Holmskioldia speciosa,** *Hutchinson et Corbishley* [Verbenaceae-Viticeae]; affinis *H. tettensi*, Vatke, sed foliis late ovatis crasse crenatis infra conspicue glandulosis calyce fructifero distincte lobato differt.

Ramuli lignosi, teretes, breviter et molliter pubescentes, lenticellis pallidis notati, internodiis circiter 2 cm. longis. *Folia* late ovata, apice triangularia, basi late cuneata, 2·5–4 cm. longa, 2–3 cm. lata, crasse crenata, crenis paucis (circiter 3) rotundatis, supra brevissime setulosa, infra pallidiora, conspicue glandulosa et breviter pubescentia, nervis lateralibus utrinsecus circiter 3 utrinque prominulis pubescentibus, venis laxis infra distinctis; petioli 7 mm. longi, dense pubescentes. *Flores* in cymas axillares paucifloras usque ad 4 cm. longas dispositi; pedunculi graciles, molliter pubescentes; bracteae inferiores plus minusve foliaceae, spatulato-obovatae, usque ad 7 mm. longae; pedicelli ad 1·2 cm. longi, supra medium bracteolis oppositis linearibus pubescentibus minime 2 mm. longis. *Calyx* coloratus, accrescens, late turbinatus, extra glanduloso-pubescens, tubo 1 cm. longo, lobis late rotundatis apice mucronulatis nervosis rigide membranaceis fructiferis patulis usque ad 2·5 cm. expansis. *Corolla* 2–2·5 cm. longa, extra glandulosa et molliter pubescens; tubus ad 1·5 cm. longus, lobis circiter 0·6–1 cm. longis laxe pubescentibus. *Stamina* longe exserta, circiter 2·5 cm. longa, filamentis glabris, antheris 2 mm. longis. *Ovarium* superne pallide tomentosum; stylus stamina paullo excedens, gracilis, glaber. *Fructus* truncatus, 4-corniculatus, calyce accrescente inclusus.

South Africa. Transvaal: Komati Poort, 29 Nov. 1917, *I. B. Pole-Evans* 16879.

Holmskioldia is a small genus of *Verbenaceae* with a very curious distribution. In the foothills of the Himalaya (3000–5000 ft.) and in the Khasia Hills of India it is represented by one species *H. sanguinea*, Retz; in the basin of the lower Zambesi and Shiré Rivers of East Africa, *H. tettensis*, Vatke, *H. spinescens*, Vatke, *H. mucronata*, Vatke, occur; an unnamed species (Ambongo, *Perville* 672) has been found in Madagascar, while the new species described above, comes from the North-Eastern Transvaal. The genus is separated from *Clerondendron* and *Vitex*

by the rather frail characters of the simple leaves associated with the coloured accrescent calyx, which characters individually occur in both these genera. The distribution, however, might probably be explained by separate evolution from either of these genera in the respective areas.

1.—*Holmskioldia speciosa*, slightly reduced; 2.—opened calyx showing fruit × 2; 3.—corolla × 2.

1657. **Vitex Pooara**, *Corbishley* [Verbenaceae-Viticeae]; affinis *V. isotjensi*, L. S. Gibbs, sed minus hirsuta, foliolis angustioribus, cymis laxioribus, bracteis minoribus differt.

Arbor, ramis junioribus primum lanato-tomentosis demum ferrugineo-pubescentibus, vetustioribus glabrescentibus. *Folia* 3–5-foliolata; foliola sessilia, obovata, basi cuneata, apice rotundata et breviter cuspidata, 4–7·5 cm. longa, 1·7–3 cm. lata, supra breviter puberula, subtus pubescentissima et minute glandulosa, nervis secundariis utrinsecus 9–14 infra prominentibus; petioli usque ad 8·5 cm. longi, breviter tomentosi. *Inflorescentia* axillaris, foliis brevior; pedunculi usque ad 4 cm. longi, cymarum ramuli circiter 1 cm. longi, tomentosi; pedicelli circiter 1·5 mm. longi; bracteae lineares, 2–3 mm. longae, tomentosae. *Calyx*

campanulatus, obscure obliquus, ore 3 mm. diametro, repando-dentatus, intra glaber, extra hirsutus. *Corolla* (imperfecta tantum visa) bilabiata, calyce parum longior, extra breviter tomentosa, 3–5 mm. longa, lobis circiter 1 mm. longis, alabastro incurvis. *Stamina* inclusa. *Stylus* circiter 5 mm. longus, filiformis, breviter puberulus. *Fructus* drupaceus, ellipsoideo-globosus, usque ad 1·5 cm. diametro, 1·7 cm. longus, leviter 4-lobatus, basi calyce accrescente cupulari circiter 8 mm. longo cinctus.

South Africa. Transvaal: Modder Nek; Nijlstroom, Jan. 10, 1920, *I. B. Pole-Evans* 19671 (type); Nijlstroom to Springbok Flats, March 6, 1904, *J. Burtt-Davy* 1722; near Warm Bath, Waterberg, Jan. 1906, *H. Bolus* 12233.

Vernacular name "Pooar" (Burtt-Davy).

1658. **Hymenocardia capensis,** *Hutchinson* [Euphorbiaceae-Phyllantheae]; affinis *H. ulmoidi*, Oliv., sed foliis plantae foemineae minoribus apice rotundatis (haud breviter acuminatis), fructus lobis apice imbricatis differt; syn. *H. ulmoides*, var. *capensis*, Pax in Engl. Bot. Jahrb. xxviii. 22; *H. ulmoides*, Hutchinson in Dyer, Fl. Cap. v. 410, partim, non Oliv.

Frutex circiter 1·25 m. altus et 1·75 m. diametro; ramuli juniores brevissimi, puberuli, annotini cinerei, glabri. *Folia* oblanceolata vel obovato-elliptica, basi breviter cuneata, apice rotundata, 1–2 cm. longa, 0·7–1 cm. lata, firme chartacea, glabra, infra pallida; nervi laterales utrinsecus 3–4, prominuli; petioli 2–3 mm. longi, puberuli; stipulae mox deciduae. *Inflorescentiae* ♂ in ramulis lateralibus brevibus confertae, circiter 1·3 cm. longae; axis gracillimus, puberulus; bracteae late spathulatae, ciliatae. *Calyx* profunde 5-lobus, lobis rotundatis dense ciliatis. *Racemi* ♀ ramulos laterales breves terminantes, usque ad 4-flori; pedicelli fructiferi graciles, 4–8 mm. longi, glabri. *Fructus* breviter stipitati, late orbiculares, late alati, circiter 1·5 cm. diametro, glabri, alis basi connatis apice imbricatis.

South Africa. Delagoa Bay; Matola, *Schlechter* 11725 ♂. Polana, near Lorenzo Marques, sandy soil, fr. 11 Jan. 1920, *J. M. Borle* 301 (Herb. Pretoria).

In dealing with this genus for the Flora Capensis I had only Schlechter's male specimen before me, and it was considered to be a form of *H. ulmoides*, Oliv., from Tropical Africa. The arrival of a good fruiting specimen collected near Lorenzo Marques, and communicated by the Chief of the Division of Botany, Pretoria, shows this Delagoa Bay plant to be an undescribed species, differing from *H. ulmoides* in its smaller and round-tipped leaves and the overlapping wings of the fruit.

1659. **Phyllanthus inflatus,** *Hutchinson* [Euphorbiaceae-Phyllantheae]; inter species africanas ramulis vetustioribus pulviniformibus hornotinis solitariis vel geminatis elongatis, fructibus magnis inflatis valde distincta.

Frutex 5–6 m. altus; ramuli vetustiores breves, pulviniformes, perulis persistentibus ornati; ramuli hornotini elongati, usque ad 30 cm. longi, graciles, glabri. *Folia* ovata, breviter subacute

acuminata, basi rotundata, 4–4·5 cm. longa, circiter 2 cm. lata, tenuiter chartacea vel submembranacea, glabra, utrinque laxe reticulata; nervi laterales utrinsecus circiter 7, a costa sub angulo fere 90° abeuntes, infra prominentes; petioli 2·5 mm. longi, teretes, glabri; stipulae subulatae, acutae, 3 mm. longae. *Flores* non visi. *Fructus* vesiculosi, magni, circiter 3 cm. diametro, siccitate pallide virides vel straminei, glabri. *Semina* oblique reniformia, circiter 6 mm. lata, striata.

Tropical Africa. Eastern Sudan: Lado; Yei river, shrub 15–20 ft., *F. Sillitoe* 321.

This is a very remarkable species of *Phyllanthus*, and easily distinguished amongst the African species by its pulviniform older branches and large bladder-like capsules.

1660. **Bobartia Keetii**, *Phillips* [Iridaceae - Aristeae]; affinis *B. gracili*, N.E. Br., et *B. robustae*, Baker, sed ab illa capsulae valvis rugosis, ab hac habitu graciliori pedicello pubescente, bracteis paucioribus differt.

Planta 30–60 cm. alta. *Rami* paullo compressi, glabri. *Inflorescentia* 2–4-florifera. *Spatha* 3–6·5 cm. longa, acuminata, glabra. *Bracteae* 5, 1·5–2·5 cm. longae, lanceolatae, acutae vel aristatae, glabrae. *Pedicellus* 5 mm. longus, pubescens. *Tubus* 4 mm. longus, 3 mm. latus, glaber; lobi 1·7 cm. longi, 0·6–1 cm. lati, ovato-oblongi, apice emarginati callosique. *Filamenta* 2 mm. longa, linearia; antherae 9 mm. longae, lineares. *Ovarium* 7 mm. longum, 2·5 mm. latum, glabrum, paullo rugosum; stylus 6·5 mm. longus, linearis; lobi truncati, apice papillosi. *Fructus* 0·6–1 cm. longus, 5–9 mm. latus, tuberculatus. *Semina* 3 mm. longa, curvata.

South Africa. Knysna Division, *Keet* 26 and in *National Herbarium* 799.

Approaches *B. gracilis*, N.E. Br., in habit but differs in having rugose valves in the capsule. In this respect it is allied to *B. robusta*, Baker, but has a more slender habit.

Named in compliment to Mr. J. D. Keet, Forest Officer at Knysna, who has been making a careful study of the local flora.

LIV.—DECADES KEWENSES

Plantarum Novarum in Herbario Horti Regii Conservatarum.

DECADES C.–CI.

991. **Berberis Osmastonii**, *Dunn* [Berberidaceae - Berbereae]; *B. pruinosae*, Franch., affinis, sed floribus solitariis brevipedunculatis, foliis linearibus distincta.

Frutex pumilus, robustus, saepius 15 cm. altus, omnino glaber, ramis hornotinis angulatis lucidis flavis, vetustioribus griseis; spinae trifidae, graciles, 1–1·5 cm. longae. *Folia* 5–7-nim fasciculata, linearia, integerrima, apice pungentia, basi cuneata, sessilia, supra viridia, subtus eburnea, utrinque nitentia, enervia,

margine paullo involuta, 1·5–2 cm. longa, 3 mm. lata. *Flores* axillares, solitarii, erecti, flavi, 0·7–1 cm. diametro; pedicelli 5 mm. longi, basi bracteis minutis linearibus suffulti. *Sepala* externa aequalia, lineari-lanceolata, 2 mm. longa. *Petala* gradatim majora, ad 6 mm. longa, obovata, basi attenuata, duobus nectariis instructa. *Stamina* ovarium aequantia. *Ovarium* breviter stylosum. *Fructus* ovoideus, atro-coeruleus, glaucus, 1 cm. longus.

Central Himalaya: Garhawl 2700–3000 m., *Osmaston* 225 (fruit) 18-5-15; Kheta Nawali Reserve at 2900 m., *Osmaston* 894, 919 (flowers) 15-5-18.

Osmaston's Barbery should be placed in Schneider's enumeration as No. 35a, next to *B. pruinosa*, Franch. (see *C. K. Schneider* in *Bull. Herb. Boiss.* Series 2, v. 400).

992. **Erysimum Melicentae,** *Dunn* [Cruciferae-Sisymbrieae]; ab *E. odorata*, Ehrh., floribus majoribus, petalis aurantiacis, siliquisque erectis distinctum.

Herba biennis, 30–70 cm. alta. *Caulis* saepe simplex. *Folia* radicalia et caulina lineari-lanceolata, apice acuta, basi attenuata, sessilia, 6–8 cm. longa, distanter et obscure dentata, pilis bipartitis et tripartitis appressis mixtis obsita. *Racemi* primo densiflori, demum longe extensi. *Flores* magni, 1·5 cm. longi et lati, aurantiaci; pedicelli 5 mm. longi. *Sepala* erecta, linearioblonga, obtusa, appresse puberula, membranacea, venosa, 8–9 mm. longa; lateralia basi saccata. *Petala* ampla, sepalis duplo longiora; unguis gracilis, laminae obovatae aequalis. *Stamina* sepalis aequilonga vel sublongiora, longioribus superne dilatatis dorso subalatis. *Antherae* lineares, profunde bilobae. *Ovarium* 4-gonum; stylus elongatus; stigma discoideum, dilatatum. *Siliquae* striatae, erectae, pedicellatae, canae, tetragonae, 4–6 cm. longae, stylo subgracili terminatae; valvae carinatae, nervo medio valido percursae; replum tenue; septum completum, enerve. *Semina* plurima, conferta, 1-seriata; testa punctulata.

India. Kashmir; 2300–2700 m., *T. Thomson;* pass of Darawai, 3000 m., *Winterbottom;* on the South side of Fezipore Nullah close to Gulmarg, *Melicent Wathen.*

In the Fl. Brit. Ind. i. 154, Hooker doubtfully refers certain Kashmir specimens to the European *E. odoratum*, Ehrh. (Beitr. vii. 157). Further knowledge of that plant justifies Hooker's caution and shows it to be necessary to find a new name for the Kashmir plant. The above diagnosis is drawn from flowering specimens in the Kew herbarium together with Thomson's notes on the fruit. Among the other material at Kew is a small specimen presented along with her other dried plants by Mrs. Wathen, and the opportunity is taken of dedicating it to her and at the same time of placing on record the numerous additions to the Indian flora which have been recognised from her beautiful coloured sketches of Kashmir plants supported by correspondingly numbered dried specimens. Such are *Moneses uniflora*, Gray (previously known no nearer than Turkestan), and *Tulipa praecox*, Ten., from Persia.

993. **Dioticarpus,** *Dunn*, gen. nov. [Dipterocarpaceae]; a *Balanocarpo*, Bedd., sepalis 2 in alas breves auriformes auctis differt.

Calycis tubus subnullus, toro adnatus; lobi sub anthesi breves, obtusi, ita imbricati, ut bases interiorum ab exterioribus fere occlusae; lobi maturi 2, caeteris bis longiores, patentes, recurvi. *Stamina* 15; filamenta basi expansa; antherae ovatae, connectivo in capillum producto. *Ovarium* 3-loculare, loculis 2-ovulatis. *Stylus* breviter subulatus. *Fructus* indehiscens, 1-spermus, intra bases calycis loborum inclusus. *Semen* globosum; cotyledones crassi, inaequales, 2–3-lobi, radicula in fossa externa prominente. —Arbores resinosae, inflorescentia cano-tomentosa. Stipulae caducae. Folia integerrima, coriacea, penninervia, reticulato-venulosa. Flores parvi, secus ramos paniculae 1-seriatim subsessiles.

D. Barryi, *Dunn*, sp. unica.

Arbor magna, praeter inflorescentiam glabra. *Folia* longe petiolata, oblongo-lanceolata, ad apicem rotundatum angustata, basi obtusa, 9–11 cm. longa, papyracea, nervis lateralibus 10–11-paribus cum tertiis prominulis; petioli 2 cm. longi. *Paniculae* axillares, foliis breviores, ut calyces et petala extus omnino breviter albo-tomentosae. *Flores* secundum ramos in uno latere subsessiles, 6 mm. longi. *Calyx* 5-lobus, 2 mm. longus; lobi ovati imbricati, 3 exteriores bases interiorum occludentes. *Petala* 5, oblonga, unguiculata, torta, apice breviter lacera. *Stamina* 15, 1–1·5 mm. longa; filamenta basi dilatata; connectivum in appendicem capillarem productum. *Ovarium* 3-loculare, 1·5 mm. longum, conicum; ovula 5–6; stylus subularis. *Fructus* indehiscens, globosus, apiculatus, 2 cm. diametro, 1-spermus, in calycis loborum basibus induratis laxe inclusus, lobis 2 exterioribus in alas patulas paullo decurvas 2–2·5 cm. longas auctis.

South India. Madras Presidency: in evergreen forest near the Kuduvarai river, 300 m., a solitary tree, *Barry;* abundant on the Tinnevelly Hills, *Beddome* 27; Kannikatti to Karyar, Tinnevelly, *Barber* 3163; Tinnevelly, *Hayne* 213B.

The tree is known to yield a very valuable timber, and was considered at the District Forest Office at Tinnevelly to be quite distinct from other allied species. Specimens were therefore sent to Kew by Mr. W. C. Hart, Deputy Forest Officer. They proved to represent a new genus near *Balanocarpus*, Bedd. It can be certainly distinguished from that genus by the two elongated fruiting sepals and by the fact that all the enlarged sepals are divided nearly down to the fruit-stalk and spread loosely round the ripe nut instead of forming a closely investing gamosepalous cup as in Beddome's genus.

994. **Indigofera cedrorum,** *Dunn* [Leguminosae-Galegeae-Indigofereae]; *T. puchellae*, Roxb., racemis pedunculatis floribus minoribus coeruleo-purpureis differt.

Frutex 1 m. altus, ramis gracilibus pallidis. *Folia* imparipinnata, 5–10 cm. longa; foliola (2–) 7–11-paria, ovata, mucronulata, 1–2 cm. longa, supra subglabra, subtus tenuiter adpresse

pubescentia; primo stipellata. *Racemi* foliis paullo breviores, pedunculis tandem duplo longiores. *Flores* subsessiles, 0·8–1 cm. longi, coeruleo-purpurei, bracteis cymbiformibus caudatis primo tecti. *Calyx* fere explanatus, 2 mm. longus, ut vexillum molliter sericeus; dentes breves, triangulares. *Vexillum* obovatum, 8 mm. longum, ungue subnullo. *Legumen* cylindricum, in acumen conicum breve subito acuminatum. *Semina* 6–10.

India. Chamba State: the commonest shrub in the undergrowth of the Deodar Forest in Chitrari Reserve, flowering in May and June, fruiting in August, 1300–2000 m., *Parker* 2, 3, 4, 41, 42, 43; Kashmir, 1700–2000 m., *Thomson*.

Mr. Parker first drew my attention last year to the probable existence of this new species in Chamba, and has since sent abundant and excellent material to substantiate his opinion. He notes, incidentally, that the first leaves produced have fewer leaflets than those appearing later in the growing season. Leaflets on the stool-shoots attain as much as 2·5 cm. in length.

995. **Caragana Hoplites,** *Dunn* [Leguminosae-Galegeae-Astragalcae]; a *C. jubata*, Poir., foliolis laxe pubescentibus (non dense villosis) prominenter venosis (nec eveniis) differt.

Frutex erectus, ad 2 m. altus, ramosus, cortice rubescente tandem griseo rugoso; rami dense foliati, undique petiolis persistentibus spinosis glabris 2·5–3·5 cm. longis horridi. *Folia* solitaria vel 2–3-na, cum bracteis 4–6 scariosis ovatis 4–5 mm. longis fasciculata, 4–5-juga, petiolata, 2–3 cm. longa; foliola oblanceolato-linearia, apiculata, 7–9 mm. longa, ut calyces laxe pubescentia pilis sericeis, nervis secondariis infra prominentibus 4–6-paribus. *Pedunculi* solitarii, e foliorum fasciculis orti, uniflori, breves, sub flore bibracteolati. *Flores* 2·5–3 cm. longi. *Calyx* tubulosus, 1·5 cm. longus; dentes lanceolati, acuminati, tubum aequantes. *Petala* alba vel pallide rosea, calyce duplo longiora; vexillum late obovatum, longe unguiculatum, lateribus reflexis; alarum auriculae lineares, unguem fere aequantes; carina cum alis vexillo brevior, basi auricula brevi instructa. *Ovarium* dense pubescens. *Legumen* non visum.

India. N. Garhwal: Nandagiri Valley, 3000–3200 m., flowering in June, *Osmaston* 1088.

996. **Centratherum Rangacharii,** *Gamble* [Compositae-Vernonieae]; *C. molli*, Benth., et *C. courtallensi*, Benth., affinis; ab utroque capitulis minoribus et foliis fere semper sessilibus differt, ab hoc etiam phyllariis scabridis, ab illo phyllariis non lanatis distinguendum.

Herba erecta, annua (?), ramulis elongatis striatis furfuraceo-villosis. *Folia* lanceolata, apice acuta, mucronata, in ramulis foliiferis basi fere amplexicaulia, in floriferis attenuata, supra strigoso-hirsuta, subtus nervis exceptis albo-tomentosa, margine paullo crenulata, 2–7 cm. longa, 1–2 cm. lata; nervi primarii utrinque 8–12, subtus conspicui et nervulis conspicuis juncti; petiolus in foliis ultimis nullus, in inferioribus praecipue in ramulis floriferis brevissimus. *Capitula* solitaria, longe-pedunculata, bracteis exterioribus 1–2 folia simulantibus munita; phyllaria inferiora basi scariosa, glabra, supra ovata, foliacea,

strigoso-hirsuta, conspicue nervosa, superiora gradatim longiora, ultima omnino scariosa; receptaculum areolatum. *Corolla* tubularis, elongata, purpurea, lobis 5 brevibus angustis. *Achaenia* glabra, obtusa, 10-costata; pappus e setis 1–4 brevibus scabris perdeciduis sistens.

South India. Tinnevelly District: Mahendragiri and Naterikal; 1914 and 1916, *K. Rangachari* Herb. Madras. 10910, 13195, 13356; Kalivayalpil to Travancore boundary, alt. (probably) from 1000 to 2000 m., May, 1901, *C. A. Barber* 3030.

997. **Vernonia anamallica,** *Beddome* MS. (Herb. Madr.) *ex Gamble* [Compositae-Vernonieae]; species distincta ramulis et foliis subtus appresse aureo-tomentosis, achaeniis pentagonis glabris sed glandulosis et corollis brevibus insignis.

Frutex erectus, ramulis crassis striatis aureo-fulvis. *Folia* elliptico-lanceolata, apice acuta, margine brevissime crenato-serrata, supra nervis puberulis exceptis glabra, subtus appresse aureo-tomentosa, 6–9 cm. longa, 2–3 cm. lata; nervi primarii utrinque 8–10, graciles, curvati, reticulatione ob lanuginem obscura; petiolus 5–8 mm. longus. *Capitula* 1 cm. lata, in corymbis subterminalibus breviter pedunculatis 5 cm. latis, pedicellata; phyllaria brevia, ovata, mucronata, pubescentia. *Corolla* brevis, 2–3 mm. longa, lobis brevibus tubum aequantibus. *Achaenia* pentagona, glabra, glanduloso-punctata; pappus exterior setaceus, brevissimus, interior ad 5 mm. longus, deciduus.

South India. Anamalai hills; in the higher ranges, 1873, *R. H. Beddome* (Herb. Madr.).

998. **Vernonia Bourdillonii,** *Gamble* [Compositae-Vernonieae]; *V. Wightianae,* Arn., affinis, foliis minoribus ad apices ramulorum congestis, corymbis paucifloris, phyllariis majoribus acuminatis differt; *V. Ramaswamii,* Hutch., etiam similis, quoad corymbos paucifloros, sed foliis brevioribus subtus fulvo-tomentosis differt.

Frutex erectus, plus quam 1 m. altus, ramulis crassis nodosis fulvo-pubescentibus foliis apices versus congestis. *Folia* oblanceolata, apice obtusa, basi attenuata, margine obscure crenata supra ad nervos et subtus dense crispato-fulvo-tomentosa, ad 5 cm. longa, circiter 1 cm. lata; nervi primarii obscuri, utrinque 6–7, curvati; petiolus vix ad 5 mm. longus, basi subamplexicaulis. *Capitula* in corymbis 1–3-natis terminalibus et axillaribus, 1–1·5 cm. lata, pedunculis ad 12 cm. longis supra bracteatis, pedunculis ultimis 1–2 cm. longis; phyllaria lanceolata, acuminata, subaequilonga (circiter 5 mm.), extus crispato-pubescentia. *Corolla* infundibularis, extus puberula, lobis brevibus. *Achaenia* 4–5-gona, plerumque 4-gona, fere glabra sed glandulosa, 2 mm. longa; pappus exterior brevis, paleaceus, fimbriatus, interior lutescens, cito deciduus.

South India. Hills of Travancore at Chimunji and other localities in grassland at elevations of 1300 m. and higher, April, 1898 and 1903, *T. F. Bourdillon* 972 and 1379; Ponmudi, Feb., 1914, *M. Rama Rae* 2363.

999. **Vernonia gossypina,** *Gamble* [Compositae-Vernonieae]; *V. salvifoliae,* Wight, annis, capitulis minoribus, foliis latioribus eximie lanatis, achaeniis trigonis glandulosis differt.

Frutex erectus, ramulis crassis albo-lanatis, ultimis lanugine longissima inter folia congesta tectis. *Folia* sessilia, lanceolata, apice acuminata, basi subamplexicaulia, margine minute serrata, supra juventute albo-sericea, demum nervis exceptis subglabra, rugosa, subtus semper lanugine alba ad costam longa tecta, ad 15 cm. longa, 5 cm. lata; nervi primarii circiter 15–16 reticulatione areolata et lanata juncti. *Capitula* in corymbis longe pedunculatis terminalibus et axillaribus 7 cm. latis, brevissime pedicellata, vix 5 mm. longa, 3 mm. lata, 5-flora; flores purpurei; phyllaria ovata, parva, marginibus araneoso-lanata, apice acuta, rufescentia. *Corolla* infundibularis, 3 mm. longa, glabra et glandulosa, lobis brevibus recurvis. *Achaenia* trigona, annulo crasso coronata, inter costas multiglandulosa, 1 mm. longa; pappus exterior paleaceus, fimbriatus, interior 3 mm. longus, paucisetosus, cito deciduus.

South India. Tinnevelly District: between Naterikal and Sengalteri; probably about 1000–2000 m., 1916–17, *K. Rangachari* 13624, 14536 (Herb. Madras).

1000. **Vernonia Heynei,** *Bedd.* MS. (in Herb. Madr.) *ex Gamble* [Compositae-Vernonieae]; *V. indicae,* C. B. Clarke, et *V. Fysoni,* Calder, similis, praecipue quoad capitula parva, sed phyllariis obtusis latis differt.

Frutex erectus, ramulis crassis sulcatis griseo-puberulis. *Folia* sessilia, elliptico-lanceolata, apice acuminata, basi attenuata et in petiolum decurrentia, margine serrata, mucronata, dentibus recurvis, supra nervis exceptis glabra, subtus dense et appresse albo-tomentosa, 10–12 cm. longa, 4–5 cm. lata; nervi primarii utrinque circiter 10, paralleli, nervulis transversis obscuris juncti. *Capitula* in corymbis pedunculatis terminalibus 10 cm. latis, pedicellata, circiter 1 cm. longa et lata et 12-flora; flores purpurei (?); phyllaria inferiora ovata, acuminata, ciliata, pubescentia, superiora obtusa et fere glabra, mucronata. *Corolla* gracilis, ad 7 mm. longa, lobis brevibus. *Achaenia* eximie 10-costata, glabra; pappus rufescens, 7 mm. longus, seriei exterioris brevissimus.

South India. Travancore Hills, *R. H. Beddome* 1873 (Herb. Madras).

1001. **Vernonia multibracteata,** *Gamble* [Compositae-Vernonieae; *V. salvifoliae,* Wight, similis, quoad lanuginem ramulorum et foliorum paginarum inferiorum, sed phyllariis et achaeniis omnino discrepans.

Frutex erectus, ramulis crassis albo-lanatis. *Folia* lanceolata, acuminata, basi attenuata et in petiolum decurrentia, margine crenulata, supra rugosa et pilis moniliformibus tecta, subtus molliter appresse albo-lanata, ad 20 cm. longa, 6 cm. lata; nervi primarii utrinque 18–20, paralleli et reticulatione obscura juncti; petiolus 1–2 cm. longus, crassus, albo-lanatus. *Capitula* in corymbis terminalibus patulis 10–12 cm. latis, lanugine alba vel

paulla fulvida tecta, pedicellata, oblonga, 1·5 cm. longa, 1 cm. lata; phyllaria permulta, lanceolata, circiter 1 cm. longa, exteriora longe acuminata, albo-araneosa, intermedia fere glabra, scariosa, superiora paullo breviora, mucronata. *Corolla* cylindrica, glabra, 4 mm. longa, lobis brevibus. *Achaenia* tetragona, angulis alatis, glabra, brevia; pappus exterior paleaceus, fimbriatus, interior e setis circiter 5 deciduis sistens.

South India. Travancore: Peermerd; 1000 m., Dec., 1880, *R. H. Beddome.*

1002. **Vernonia pulneyensis,** *Gamble* [Compositae-Vernonieae]; *V. pectiniformi*, DC., affinis, corymbis paucifloris breviter pedunculatis, phyllariis albidis apice solum coloratis et foliis ovatis paucinerviis margine distanter serratis differt.

Suffrutex subherbaceus, ramulis striatis pilis moniliformibus longis tectis. *Folia* ovata, membranacea, apice acuta, mucronata, basi in petiolum attenuata, margine distanter serrata, supra praecipue ad nervos pilis moniliformibus sparsim ornata, subtus villosa, 5–10 cm. longa, 2–4 cm. lata; nervi primarii utrinque 6–7, curvati et reticulatione juncti; petiolus gracilis, circiter 5 mm. longus. *Capitula* in corymbis terminalibus vel aliquando axillaribus subsessilia, 1 cm. longa et lata, 12–15-flora; flores purpurei; phyllaria inferiora ovata, longe mucronata, superiora gradatim longiora, ultima scariosa, straminea, obtusa, 5 mm. longa, omnia rufescentia apice excepto albido, ciliata et parce araneosa. *Corolla* gracilis, 5 mm. longa, in lobis 5 brevibus divisa. *Achaenia* eximie 10-costata, glabra; pappus albidus 5 mm. longus, cito deciduus.

South India. Pulney Hills: Banks of the Pambar river at Kodaikanal; 2300 m., in thin forest, April, 1916, *P. F. Fyson* 4057, 4130.

1003. **Vernonia shevaroyensis,** *Gamble* [Compositae-Vernonieae]; *V. volkameriaefoliae*, DC., affinis, capitulis unifloris et foliis subtus scabride pubescentibus differt.

Arbor parva (?) ramulis crassis ultimis nigris pubescentibus. *Folia* oblanceolata, apice acuta, basi in petiolum brevem crassum attenuata, margine integra vel repando-crenata, supra nervis exceptis glabra, subtus scabride pubescentia, 16–24 cm. longa, 5–8 cm. lata; nervi primarii utrinque 10–12, distantes, prominuli, marginem versus curvati et nervulis irregularibus prominentibus juncti; petiolus vix 1 cm. longus. *Capitula* in paniculis terminalibus numerosa, parva, uniflora; flores purpurei (?); phyllaria oblonga, dorso sericeo-villosa, inferiora parva, obtusa, superiora longiora, acuta. *Corolla* elongata, circiter 1 cm. longa, ad medium in lobos 5 lineares divisa, extus puberula. *Achaenia* obscure 10-costata, costis vix prominentibus, basin versus attenuata, inter costas glandulosa; pappus stramineus, 1 cm. longus, setis exterioribus et interioribus aequalibus.

South India. Shevaroy Hills; *Perrottet* collection, no. 376 (Herb. Calcutta).

1004. **Helichrysum perlanigerum,** *Gamble* [Compositae-Inuloideae]; *H. Wightii*, C. B. Clarke, affinis, lanugine molli

floccosa cinnamomea conspicua, foliis latioribus tenuioribus costis non appressis et bracteis involucri interioribus acutis differt.

Suffrutex perlaniger, scaposus. *Folia* basalia stellatim patentia, e basi lata lanceolata, acuta, submembranacea, 5-costata, utrinque lanugine molli cinnamomea praedita, 6–7 cm. longa, 2–2·5 cm. lata, caulina lanceolata, acuta scapo-appressa, 2–3 cm. longa, 1 cm. lata. *Flores* capitulorum exteriores ♀, in una vel aliquando duobus seriebus, interiores permulti, ♀, omnes fertiles; capitula sessilia ad ramos corymbi terminalis congesta, inflorescentiam ad 10 cm. latam formantia; rami et ramuli et capitula ad basin lanugine molli cinnamomea dense tecti. *Bracteae* involucrantes albidae vel flavo-albidae, ovatae, exteriores obtusae, interiores acutae. *Corollae* florum ♀ graciles, 2–3-dentatae, florum ♀ tubulares, lobis 5 patentibus glandulosis. *Achaenia* minuta, obovoidea, minute squamosa; pappus uniserialis, parce plumosus.

South India. Anamalai Hills of Coimbatore; about 2000 m., *R. H. Bedome* (Herb. Madras).

1005. **Senecio Lawsoni,** *Gamble* [Compositae-Senecionideae]; *S. lavandulifolio*, DC., affinis, foliis minoribus per totum caulem regulariter dispositis, corymbis paucifloris et ligulis plurinerviis differt.

Herba perennis erecta, ramulis e basi gracilibus ad 35 cm. longis villosis. *Folia* linearia, sessilia, apice mucronata, marginibus ad costam reflexis, 10–17 mm. longa, costa villosa excepta glabra. *Capitula* in corymbo terminali 1–6-cephalo, circiter 10–15 mm. lata; floribus exterioribus ♀ 15–20 ligulatis, interioribus ♀ tubulosis, omnibus flavis fertilibus. *Phyllaria* circiter 20, lineari-lanceolata, apice acuta ciliata, margine scariosa, dorso albo-villosa, infra bracteis brevibus linearibus munita, 5–7 mm. longa. *Corollae* florum ligulatorum reflexae, 2 mm. latae, 5–7-nerves florum tubulosorum graciles, 4 mm. longae, lobis 5-parvis. *Antherae* basi ecaudatae. *Achaenia* anguste oblonga, glabra, pauci-costata. *Pappus* albus, disci floribus aequalis.

South India. Nilgiri Hills: on grassy downs between Avalanché and Sispara; about 3000 m., Nov. 1883, *J. S. Gamble* 13427; Nov. 1887, *M. A. Lawson* 44.

1006. **Diospyros impressa,** *Dunn et R. Williams* [Ebenaceae]; a *D. Brandisiana*, Kurz, cui quoad inflorescentiam floresque consimillima, foliis adultis subtus molliter pubescentibus et nervis circiter 16-jugis supra impressis venisque transversis supra plane obscuris differt.

Arbor dioica, cortice griseo-brunneo. *Folia* chartacea, elliptico-oblonga vel oblongo-lanceolata, apice acuminata, basi acuta, adulta supra glabra, subtus ferrugineo-pubescentia, 21–27 cm. longa, 5–9 cm. lata, nervis 16-paribus supra impressis subtus prominentibus, venis transversis plane obscuris. *Cymae* densiusculae, ramosissimae, in ligni vetusti nodis congestae, ut bracteae et calyces atro-fusco-tomentosae; bracteae minutae, oblongo-lanceolatae. *Flores* ♀ tantum visi.

Calyx 2 mm. longus, 5-partitus, lobis acutis. *Corolla* adpresse fulvo-pubescens; tubus versus basin subampliatus, 5-angularis, 6 mm. longus; lobi 5, oblongi, obtusi, 6 mm. longi. *Stamina* reducta; filamenta ad 3 mm. longa, pubescentia. *Ovarium* dense fulvo-pubescens, 10-loculare; stylus 4 mm. longus, 5-fidus. *Ovula* solitaria, suspensa.

India. Burma: Papun (about 150 miles N.E. of Rangoon), *Meebold* 17253.

1007. **Trachelospermum anceps,** *Dunn et R. Williams* [Apocynaceae-Echitideae]; *T. laurifolio*, Ridley, similis sed foliis magnis basi obtusis differt.

Arbor parva. *Folia* opposita, obovato-lanceolata vel oblongo-lanceolata, apice abrupte acuminata, basi obtusa vel rotundata, 24–38 cm. longa, 9–11 cm. lata, supra chartacea, glabra, subtus pilis brevibus sparsis mollia; nervi 16-pares, subtus prominentes, intra marginem anastomosantes, costa fortissima; petioli 1–1·5 cm. longi. *Flores* in cymis puberulis brevibus umbelliformibus circiter 10-floris; pedunculi 1–2 cm. longi; pedicelli graciles, 2–3 cm. longi, basi fracteis brevibus ovatis instructi. *Calyx* 5-partitus; lobi 5, late ovati, 4–5 mm. longi. *Corollae* tubus supra contractus, intus pilis in fauce dense instructus; lobi 5, lati, contorti, dextrorsum obtegentes, 10 mm. longi. *Stamina* in summo tubo affixa, filamentis brevissimis; antherae exsertae, acutae, basi sagittatae, circa stigma in conum conniventes et ei medio adhaerentes; connectivum dorso basi tuberculo carnoso conspicuo instructum. *Discus* annularis, 5-lobus. *Ovarii* carpella 2, primum connata; stylus filiformis, 5–7 mm. longus; stigma breve, ovatum, apiculo instructum. *Fructus* non visus. *Vallaris ? anceps*, Wall. Cat. 1622.

Lower Burma. Tenasserim: Tavoy; flowers, April 1911, *Meebold* 14966; Kyautalan, flowers, Mar. 1911, *Meebold* 15408: Mergui; Letpanthaung, flowers, Mar. 1911, *Meebold* 14654.

1008. **Hoya burmanica,** *Rolfe* [Asclepiadeae-Marsdenieae]; affinis *H. lanceolatae*, Wall., sed floribus multo minoribus et coronae lobis latioribus differt.

Fruticulus ramosus, 25–40 cm. altus. *Rami* teretes, pallidi, 20–25 cm. longi, subpenduli. *Folia* subpendula, breviter petiolata, anguste ovato-lanceolata, acuminata, subconcava, crassiuscula, glabra, glauco-viridia, 5–8 cm. longa, 1·3–2 cm. lata; petioli 5 mm. longi. *Umbelli* terminales et axillares, breviter pedunculati, pauciflori; pedunculi parce pubescentes, 5 mm. longi. *Bracteae* squamulosae, pubescentes, 0·5 mm. longae. *Pedicelli* graciles, glabri, 1–1·2 cm. longi. *Flores* circiter 1 cm. diametro, lutei, coronae basi purpureo-suffusi. *Sepala* ovato-lanceolata, subacuta, glabra, 2·5 mm. longa. *Corolla* rotata, circiter 1 cm. diametro, velutina: lobi ovati, apice recurvi, acuti. *Coronae* lobi stellato-patentes, elliptico-ovati, obtusi, subconcavi 2·5 mm. longi, basi purpurei.

India. Burma; Chin Hills.

Flowered in the Orchid House of Lieut.-General Sir Arthur

G. F. Browne, K.C.B., Lower Bourne, Farnham, Surrey, in August, 1920, the plant having been received with a number of Orchids from a friend in the Chin Hills, Burma.

The flowers are deep yellow, with a red-purple stain at the base of the corona-lobes.

1009. **Tupistra veratrifolia,** *Kurz MS. ex Dunn* [Liliaceae-Aspidistreae]; a *T. Stoliczkana,* Kurz, perianthii tubo 1–2 mm. (non 3 mm.) longo, pedunculo spicam aequante (non bis longiore) differt.

Herba robusta, rhizomate repente crasso. *Folia* basi cataphyllis oblongis obtusis membranaceis tandem fibrosis cincta, 1–3, oblanceolata, acuminata, 1 m. alta, 10–15 cm. lata, in petiolum 15–20 cm. longum attenuata, integerrima, glabra, nitentia. *Spicae* erectae, densiflorae, sub anthesi ad 7 cm. longae, fructu 25 cm. longae, pedunculo aequilongo suffultae; bracteae floribus breviores. *Flores* 7·5 mm. diametro, glabri. *Perianthii* tubus brevissime campanulatus, 1–2 mm. longus; lobi 6, patentes, oblongi, obtusi, 3 mm. longi. *Stamina* 6; filamenta brevissima, tubo inserta, perianthii lobis opposita. *Ovarium* parvum, sessile, 3-loculare; stigma peltatum, trilobum, ovario latius. *Bacca* immatura globosa.

India. Khasia Hills and Brahmaputra plains, *Kurz.* Eastern Himalaya. Outer Abor Hills, Janakmukh, *Burkill* 37281. December 19th, 1911.

The two sheets from which the flowering plant is described were found under a cover in the Calcutta Herbarium inscribed with the above name in Kurz's handwriting. They represent the type of the species. Both were lent to Kew to compare with Burkill's fruiting specimen with which they agree. The opportunity is taken of publishing Kurz's MS. name. One of the sheets is returned to Calcutta, the other by Lt.-Col. A. T. Gage's courtesy is retained in the Kew Herbarium.

1010. **Arundinaria Murielae,** *Gamble* [Gramineae-Bambuseae]; species formosa, *A. nitidae,* Mitford, affinis, foliis petiolatis majoribus longissime setaceo-acuminatis differt.

Frutex caespitosus, ramosissimus, culmis gracilibus aureis glabris sed juventute insigniter cera alba munitis circiter 7–10 mm. diametro 2–4 m. altis, internodiis inferioribus 20 cm. longis. *Vaginae* culmorum stramineae, striatae, glabrae sed margine ciliatae, apice rotundatae, vix auriculatae, 10–12 cm. longae; pseudophylla reflexa, 4–6 cm. longa, angustissima, ligula perbrevi. *Folia* oblongo-lanceolata, submembranacea, apice longissime setaceo-acuminata, basi plus minusve rotundata, 7–12 cm. longa, 1–1·5 cm. lata, marginibus hyalinis praecipue superne scabris, nervis secundariis utrinque 4–5, venulis transversis permultis conspicuis approximatis; petiolus gracilis, 3–4 mm. longus; vaginae striatae, glabrae, ore paullo productae et ciliis 1–3 cito deciduis munitae; ligula 1 mm. longa, brevissime ciliolata. *Ramuli* foliacei, ad nodos culmorum aggregati, unus vel duo satis longe producti, reliqui breves, omnes basi bracteis stramineis culmorum

vaginis similibus muniti. *Flores* et caryopsis adhuc ignoti. *Arundinaria* sp., Rendle in Plantae Wilsonianae, ii. 64.

China. Western Hupeh: Fang Hsien, uplands at 2000–3000 m. alt., *E. H. Wilson* 1462.

Description from specimens taken from clumps cultivated in the Bamboo Garden, Royal Botanic Gardens, Kew, in August 1920 (by W. J. Bean and J. S. Gamble). By Mr. Wilson's special wish the species is dedicated to his daughter, Muriel Wilson.

This Bamboo was presented to Kew from the Arnold Arboretum in the autumn of 1913. A single plant came in a pot, and this was divided up into about half a dozen pieces, which were repotted and grown for a few months in a greenhouse. They were then planted out in the collection of Bamboos near the Rhododendron Dell where they have grown luxuriantly and promise to be as ornamental as any hardy species. They are at present (October 1920) about 8 ft. high forming dense masses of culms, the outer ones of which arch outwards towards the top and give the plants a very graceful appearance. In growth *A. Murielae* resembles *A. nitida*, Mitford, more closely than any other hardy species in cultivation, but the culms are stouter and the leaves larger. Moreover, Mr. E. H. Wilson, who collected and first introduced it to cultivation, informs me that the old culms are rich yellow; in *A. nitida* they are purple-black. On the whole *A. Murielae* is a distinct and most attractive addition to hardy bamboos. W. J. Bean.

LV.—NOTES ON THE BALSAMS OF CHITRAL AND THE KACHIN HILLS.

By the late Major S. M. Toppin, R.A., M.C.

In a previous number (*Kew Bull.*, 1918, 156), the bequest to Kew was announced of a large collection of Indian plants in accordance with the will of Major Toppin. The excellent set of *Impatiens* which it included, accompanied by typewritten descriptive notes by himself and coloured sketches was specially noted. These proved to be of great value and as they were almost ready for publication the following paper has been arranged with such few additions as were necessary by Mr. S. T. Dunn, B.A., Assistant for India in the Herbarium. The paper is followed by some extracts from Sir Joseph Hooker's letters to Major Toppin on the subject of his *Impatiens* collections.

Fertilization of Burmese Impatiens.

For the purpose of discussing the fertilization of the Balsams found in Burma, I have divided the species up into three main groups according to the relative positions of the different portions of the flower—

(1) The vexillum and alae patent and in such position to each other as to close the lip.

(2) Mouth of the lip fully open owing to the divergent positions of the lobes (distal) of the alae which are contorted over each other.

Group (1). The two species of this group have very elongated spurs and I have never seen any insect enter a flower. In neither is there an auricular lobe. I think that most probably this group is fertilized by moths at night.

Group (2). Except in the single case of *I. cymbifera*, Hook. f., all the species of this group have extremely developed auricular lobes. All noticed are visited by butterflies and bees during daytime. The action is as follows:—The butterfly alights directly upon the auricular lobes thus getting a purchase, and at the same time has its body forced up against the pollen owing to the height of the lobes. If the lobes did not exist, the insect in many species could crawl directly into the mouth and rob the honey without coming into touch with the anthers. Further, it may be noticed that in all species the lobes are bright orange, a very distinctive colour as compared with the remainder of the flower, so as to attract the butterfly.

Group (3). Here the mouth is closed by the contorted wings and all species are devoid of auricular lobes. These species also are visited at day by butterflies and bees. Auricular lobes, if present, would be hidden by the contorted wings. The flowers are however smaller as in *I. graciliflora*, Hook. f. and I. *drepanophora*, Hook. f. and many more, and the insect, in actually forcing its way into the mouth, is driven against the anthers.

Dehiscence of the Capsules of Burmese Impatiens.

In dividing the *Impatiens* of Burma into the main sections:

(*a*) species with a short turgid capsule and

(*b*) species with a linear or clavate capsule,

the writer has found that in the species collected by him in Burma (some 25) there is also a most profound difference both in the character of the tissue of the capsule itself and also in the method by which the ripe seeds are ejected, and these two differences group themselves without a single exception in exact accordance with the above sections.

Section (*a*). The entire capsule is composed of thick glistening elastic tissue, and the seeds are distributed throughout the entire length of the pod.

The method of dehiscing consists of two quite distinct motions, and is as follows:—(1) The capsule opens only along one suture commencing at the centre, and the dehiscence spreading at an equal rate towards both the apex and the base till it is entirely opened. (2) The seeds are now rapidly ejected by the upper half of the capsule folding down over the lower half.

Section (*b*). Only the lower portion of the capsule is composed of thick glistening elastic tissue, and this is devoid of seeds; the upper portion is merely a thin membranous bag with no elastic property, and its only use is as a receptacle for the seeds. The

method of dehiscence is as follows:—The capsule splits at the base along all its five sutures at once and the several elastic portions roll up towards the apex, the motion being so rapid that when the limit of the elastic half of the capsule has been reached the membranous portion is torn to pieces and the seeds are thrown out. It will be noticed that here there is only one motion.

It would appear probable that in those species in which the bag is at the base and the elastic portion is at the apex it would be found that the action would be similar except for the fact that the sutures would all split first at the apex and the several portions would coil inwards and downwards instead of outwards and upwards, but no actual species of this kind have been collected in Burma by the writer although, no doubt, they are common. To such an extent is the distribution of the seeds dependent on the tearing to pieces of the membranous bag by the force of the elastic half, that if the capsule is held at the juncture of these two tissues till the force of the elastic portion is expended and then released, it will be found that the bag containing the seeds has lost all power of splitting up and ejecting them.

List arranged as in Sir J. D. Hooker's Epitome (Rec. Bot. Surv. Ind. iv. 1).

1.—Species of the Western Himalaya.

§ 1.

1. **I. Balsamina,** *L.;* Almora. *Toppin* 3444.

§ 2.

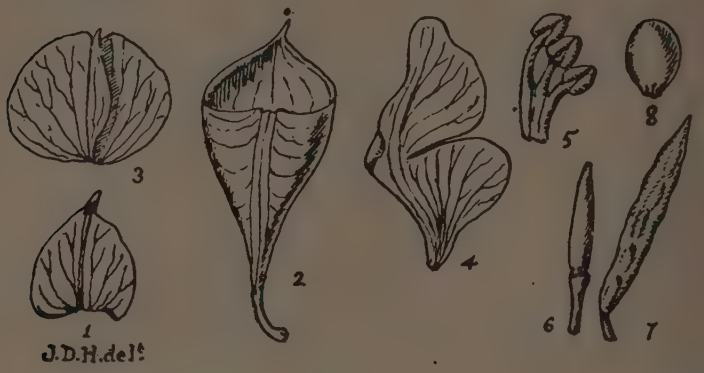
2. **I. Roylei,** *Walp.;* Gilgit, 1909, *Toppin* 1035 (in part).

I. Roylei, Walp.—Fig. 1, lateral sepal; 2, sepal with spur; 3, standard; 4, wing.*

* In making the drawings for this paper Miss Smith wishes it to be noted how greatly she has been helped by Major Toppin's beautifully selected and dried dissections. It would have been impossible in some cases to understand the flowers without them. Sir J. D. Hooker was much handicapped in his work on *Impatiens* by want of dissections properly prepared in the field.

The help of various artists is acknowledged at the foot of the drawings when their work has been used.

8. **I. Lemanni,** *Hook. f. & Thoms.;* abundant in Chitral from 1220–2740 m.



I. Lemanni, Hook. f. & Thoms.—Fig. 1, lateral sepal; 2, spurred sepal; 3, standard; 4, wing; 5, stamens; 6, ovary; 7, capsule; 8, seed.

13. **I. Edgworthii,** *Hook. f.* var. **Toppinii,** *Hook. f.* MS. var. foliis verticillatis.

Chitral: Ziarat; 2300–2700 m., Aug. 1908, *Toppin* 605.

I. Edgworthii, Hook. f. var. *Toppinii,* Hook. f.—Fig. 1, bract; 2, lateral sepal; 3, spurred sepal; 4, standard; 5, wing; 6, stamen; 7, capsule; 8, seed.

§ 3.

17. **I. brachycentra,** *Kar. & Ker.;* Chitral, Lowari Pass at 2700 m., June and July, flowers white, *Toppin* 405.

I. brachycentra, Kar. & Ker.—Fig. 1, lateral sepal; 2, spurred sepal; 3, standard; 4, wing; 5, stamens; 6, capsule.

§ 5.

20. **I. cristata,** *Wall.;* Wight Ic. t. 323. Western Himalaya, Almora at 1220 m., *Toppin* 3446.

III.—Species of the Burmese Region.

§ 2.

2. **I. pulchra,** *Hook. f. & Thoms.;* Kachin Hills, Warao Hka, growing in sunny positions at 470 m., the roots clinging to the face of the damp rocks. Dec. 1911. *Toppin* 4242; also at Sinlum at 1300 m. *Toppin* 2747.

I. pulchra, Hook. f. & Thoms.—Fig. 1, flower; 2, lateral sepal; 3, spurred sepal; 4 and 5, petals.

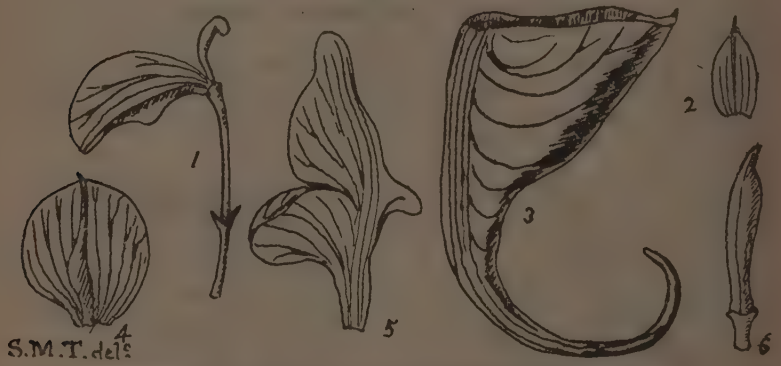
Wings, spur and standard all the same tinge of copper red, the spur lined with a deeper shade but with no blotch. Sepals usually 4, the lower light green in colour as the flower. Capsule turgid, entirely composed of thick contractile tissue. Seeds, average number in 3 capsules examined 18·3 (11–19).

2a. **I. erubuscens,** *Dunn;* species *I. delicatae,* Toppin, affinis, sed caulium foliorumque colore distincta.

Herba erecta, grandiflora, caule rubro tomentello 10–20 cm.

alto simplice superne folioso. *Folia* alterna, lanceolata, apice basique acuta, 4–7 cm. longa, 1·5–2·5 cm. lata, dentibus apiculatis concinne crenata, apiculis in grandulas longe stipitatas basi gradientibus, subglabra, supra atro-viridia, subtus pallide rubra, nervis rubris 5–6-paribus; petioli 0·5–1·5 cm. longi. *Pedunculi* ex axillis superioribus 1–3-flori, 2–6 cm. longi; bracteae lineares, 3 mm. longae. *Flores*, calcare incluso, ad 4 cm. longi rosei; pedicelli 1–1·5 cm. longi. *Sepala* 2 lateralia ovato-lanceolata, acuminata, 8 mm. longa, 5–6-nervia, tenuissima; posticum ex ore cymbiformi 2·5 cm. lato 8 mm. alto in calcar tenue semicirculare 3 cm. longum abiens. *Vexillum* orbiculare, ad 1 cm. diametro; costa dorso medio breviter carinata. *Alae* 2·5–3 cm. longae, basi cuneatae; lobus basalis late oblongus; distalis longior, obtusus; auricula dorsalis conspicua, flava. *Filamenta* 7 mm. longa; antherae connatae. *Capsula* glabra, turgida, 1·5 cm. longa. *Semina* circiter 45.

Kachin Hills. Kao Hka gorge: in crevices on the face of cliffs; 550 m., January 1912, *Toppin* 4362.



I. erubescens, Dunn—Fig. 1, part of inflorescence; 2, lateral sepal; 3, spurred sepal; 4, standard; 5, wing; 6, pistil.

2b. **I. delicata,** *Toppin;* species *I. pulchrae*, Hook. f. & Thoms., affinis, sed foliorum nervis 4–5-paribus distincta.

Herba ascendens, glaberrima, gracilis, 8–12 cm. alta, caule brevi. *Folia* alterna, lanceolata, crenata, subtus pallida, 3–5 cm. longa, in petiolum 1 cm. longum angustata, nervis utrinque 4–5; glandulae stipulares nullae. *Pedunculi* 2 cm. longi, uniflori vel biflori, foliis breviores; pedicelli 1–1·5 cm. longi, inferiores basi, superiores altius bracteati; bracteae parvae. *Flores* ad 3·5 cm. expansi, rosei. *Sepala* 2 lateralia rosea, ovato-lanceolata vel lanceolata, acuminata, ad 1 cm. longa; labelli limbus cymbiformis, roseus, in calcar 3 cm. longum fere rectum attenuatus, ore ad 2 cm. longo horizontali. *Vexillum* roseum, orbiculare, ad 13 mm. diametro; costa dorso medio breviter carinata. *Alae* ad 3 cm. longae, roseae; lobus basalis rotundatus; lobus distalis oblongus; auricula dorsalis conspicua, roseo-flava. *Capsulae* turgidae.

Kachin Hills. Sumprang; 420 m., 30.12.11, *Toppin* 4287.

I. delicata, Toppin—Fig. 1, whole flower; 2, lateral sepal; 3, spurred sepal; 4, standard; 5, wing; 6, pistil.

9. **I. violaeflora,** *Hook. f.;* Kachin Hills, Sinlum, 1370–1520 m.; *Toppin* 2679.

I. violaeflora, Hook. f.—Fig. 1, flower; 2, lateral sepal; 3, spurred sepal; 4, standard; 5, wing; 6, capsule.

An erect branched and hairy plant 15–45 cm. in height. *Stem* glabrous or slightly hairy on the upper portion, not swollen at the nodes. *Stipular glands* and stipules nil. *Leaves* alternate, crowded at the top of the stem, ovate-lanceolate, covered with white scattered hairs and with distinctive red hairs on the margins of the lower half up to 5 mm. in length. *Inflorescence* axillary, crowded and pedicelled from the upper leaf axils. Bracts minute, lanceolate, at base of pedicels. Fruiting pedicels decurved. *Flowers* rotate, deep rose in colour, reverse side of the petals being of much lighter tinge, 2 cm. in diameter. *Sepals* 2, minute. *Lip* glabrous or with a few soft hairs. The *spur* very slender up to 3·25 cm. in length, nearly straight. *Wings,* the two lobes subequal with no dorsal auricle but a yellow spot marking the position. *Standard* notched, with a slender keel, broadly cordate. *Pollen* light pink. *Pod* turgid in the centre, covered with white hairs. When ripe the line of cleavage is longitudinal, commencing from the centre of the pod which is entirely composed of thick glistening contractile tissue; when the pod has split in length it contracts on itself transversely thus ejecting the seeds. *Seeds* dark brown, rough, with no hairs when ripe, but covered with white tomentum when green. The number depends largely on the nature of the ground. Collected on the hard roadside, the average number in 10 capsules was 6·5 (6–8). Collected in boggy ground the average number in 5 examined was 12·6 (10–17). This plant is extremely variable in size and appearance but the distinctive length of the spur and the usually long red hairs on the margins of the leaves seem to be constant features.

13. **I. porrecta,** *Wall.;* N.E. Burma: Ngau Hka at 500 m.; Kao Hka gorge at 550 m.; in wet jungle but in full sunshine, Jan. 1912, *Toppin* 4359.

A delicate plant up to 45 cm. high. *Stipules* and stipular glands nil. *Flower* orange yellow. *Sepals* 2, tinged with yellow and green. The lip and standard slightly spotted with crimson.

I. porrecta, Wall.—Fig. 1, flower; 2, lateral sepal; 3, spurred sepal; 4, standard; 5, wing; 6, pistil.

Auricular lobes nil. The mouth of the lip nearly closed by the contorted wings: spur slightly curved. *Standard* with blunt keel. *Capsule* glabrous and turgid. *Seeds* globose, glabrous; average number in 2 capsules examined was 2·5. This plant is completely glabrous and thus is in accordance with the description in the *Flora of British India*.

13a. **I. Toppinii,** *Dunn;* species *I. porrectae,* Wall., affinis, sed floribus intense rubro-purpureis sepali postici ore cymbiformi distincta.

Herba procumbens, radicum fasciculos, pedunculos et folia ex nodis caulis et ramorum repentium teretium tomentosorum emittens. *Folia* alterna, ovata, apice basique acuta vel breviter acuminata, 4–6 cm. longa, 2–3 cm. lata, serrata dentibus parvis crebris apiculatis, utrinque hirtula, nervis 7–8-paribus; petioli 1–2 cm. longi. *Pedunculi* 1–2-flori, 1·5–4 cm. longi; pedicelli 1–3 cm. longi, medio bractea lanceolata 5 mm. longa instructi. *Flores* calcare curvato incluso 3 cm. longi, intense rubro-purpurei. *Sepala* puberula; 2 lateralia oblongo-lanceolata, acuminata, 1–1·5 cm. longa, rubro-brunnea, 3–5 nervia; posticum ex ore cymbiformi 1·5–2 cm. lato superne apiculato in calcar tenue semicirculare 2·5 cm. longum abiens. *Vexillum* orbiculare, ad 1 cm. diametro, dorso pubescens, breviter gibbum. *Alae* glabrae, basi cuneatae, 2·5–3·5 cm. longae; lobus basalis superne rotundatus; distalis longior, oblongus, obtusus; auricula dorsalis conspicua, flava. *Capsula* turgida, glabra. *Semina* 8, glanduloso-rugosa, fusco-brunnea.

Kachin Hills. Sinlum; at 1500–1800 m., June and July, 1911, *Toppin* 2781.

The dedication of this balsam to the memory of Major Toppin, who worked with such perseverance and success at the elucidation of the genus on the N.W. and N.E. frontiers of India, and who soon afterwards gave his life in the Great War in defence of the Empire, will be approved by all. It fulfils, moreover, one of the

I. Toppinii, Dunn—Fig. 1, lateral sepal; 2, spurred sepal; 3, standard; 4, wing; 5, capsule.

I. kamtilongensis, Toppin—Fig. 1, lateral sepal; 2, spurred sepal; 3, standard; 4, wing; 5, capsule.

last wishes of the greatest authority on *Impatiens*, for Sir J. D. Hooker had selected a species among the Chitral Balsams to be called after Major Toppin, but on Aug. 2, 1911, wrote to him saying that after all it was not new, being *I. Lemanni*, Hook. f. & Thoms., "you will, I hope," he added, "make up for the loss by finding a new species in Burma."

This plant is one of the commonest as well as one of the most beautiful balsams in the Kachin Hills. The Latin diagnosis has been drawn up from the discoverer's own English description.

14a. **I. kamtilongensis,** *Toppin;* species *I. khasianae*, Hook. f., affinis, sed floris colore distat.

Herba erecta, pilis fuscis hirsuta, ad 30 cm. alta, caule succulento. *Folia* ovata vel ovato-lanceolata, crenata, acuminata, subtus pallida, petiolata, nervis utrinque 7–8; glandulae stipulares nullae. *Pedunculi* 2 cm. longi, hirsuti, biflori, foliis breviores. *Pedicelli* 1–1·5 cm. longi. basi bracteati; bracteae lineares. *Flores* pallide sufflavi vel fere albi. *Sepala* lateralia 2, ovato-lanceolata, acuminata, ad 10 cm. longa, hirsuta; labelli limbus hirsutus, cymbiformis, in calcar incurvum ad 1·25 cm. longum attenuatus, ore 1 cm. longo horizontali. *Vexilli* costa dorso in medio cornuta. *Alae* 2 cm. longae; lobus basalis rotundatus, lobus distalis oblongus; auricula dorsalis conspicua. *Capsulae* turgidae, hirsutae. *Semina* orbicularia, atrofusca, circa 22.

Kamti Long Hills. Kumtat; in wet, shady places at 500 m., Sinar at 650 m., Dec., 1911. *Toppin* 4275.

In 8 capsules examined, a maximum number of 24 seeds was found, minimum 17, average 22·3.

(*See page* 355.)

17. **I. annulifer,** *Hook. f.; Toppin* 3442. Brought by Mr. Grant and not collected by myself. Differs from 2747 (*I. pulchra*, Hook. f. & Thoms.), in the leaves and from 2746 (*I. burmanica*, Hook f.), in having a distinct maroon patch on the wings like 2747, and also in the fact that the spur is completely recurved on itself. Sepals light in colour.

I. annulifer, Hook. f.—Fig. 1, flower; 2, lateral sepal; 3, spurred sepal; 4, standard; 5, wing.

Mr. Rae has seen this specimen, and also 2746 (*I. burmanica*, Hook. f.), when growing, and states that they are very different in appearance. Mr. Grant's description of colour is "Flower yellow and claret, spur yellow with brown stripes, outer wings buff, turning to yellow at base with stripes of claret and maroon, standard yellow and deep claret."

18. **I. burmanica,** *Hook. f.;* Kachin Hills, 500 m. (Kumtat), 400 m. (Pungyi), 1300 m. (Sinlum), *Toppin* 2746.

I. burmanica, Hook. f.—Fig. 1, flower; 2, lateral sepal; 3, spurred sepal; 4, standard; 5, wing.

On 29–9–11 I spent a night at Palong Gatung, below Sinlum, to attempt to settle the question of the separate identity of this species and the previous one (3442). I took up Mr. I. I. Fagan, who is an expert artist, and his painting (now at Kew), may be taken as an exact reproduction of the flower. I examined with care 43 different specimens, picking in each case a plant with a fully developed flower and also a bud. It grows invariably in water, and is not even found in the very close jungle and ground near to the water's edge. In no case was there any stipule nor any stipular gland. In every case the bract was found at the base of the pedicel. In no case was there any variation in the auricular lobes nor in their colour. In every case the spur was curled round, but in no case with a fully open flower was it recurved completely on itself. The sepals were extremely variable in colour, from greenish to deep red, but in no case were they pure green. I only found one case in which there were four sepals, although I found more than this the first time when examining fewer flowers. In no case had the wings the distinctive deep maroon markings that were invariably found in 3442 at the base, and in only two cases they were not pure cream without, viz.: (1) The inner edge of the wings had a bar of deep orange red running along it, and also a distinctive bar of the same colour running from the base to the outer edge. (2) In this flower one wing had the above marking, but not the other. I

examined 7 pods only; seeds 33–60; average in the pods were 45·6.

This plant is very local here, I only found it in one stream, and in this for only the distance of about a mile when it ceased, although if I had searched for it for a longer time I might have found it further afield. I searched other streams but did not find it, and the Kachin with me told me that it grew nowhere else. It only grew in deep shade.

25. **I. tripetala,** *Roxb.;* Hills east of Bhamo at 1500–1700 m., June and July, in shady places by roadsides and banks of streams. *Toppin* 2680.

I. tripetala, Roxb.—Fig. 1, bud; 2, flower; 3, lateral sepal; 4, spurred sepal; 5, standard; 6, wing; 7, capsule.

A stout erect glabrous *herb* or slightly pubescent and branched, 1–1·2 m. high. *Stem* glabrous or covered with a few scattered hairs, swollen at the nodes, succulent. *Leaves* ovate or ovate-lanceolate, acuminate at the end, slightly crenate, 10–13 cm. long exclusive of the petiole, which is 1·2 cm. in length; petiole with 6–12 glands on each side of the base. *Pedicels* springing from the axils of the leaves. *Flower* 2·5 cm. in length, reddish purple in colour. *Sepals* 2, lanceolate. *Lip* with an acuminate tip on the lower margin of the mouth, suddenly constricted to form the small curved spur. *Standard* orbicular, keeled. *Wings* with rounded lateral lobes and with a well marked yellow ear-shaped lobule. *Pollen* white. *Capsule* turgid. Average number of *seeds* found in 12 capsules was 21·8 (16–33); unripe seeds covered with white tomentum.

The distinctive points of this flower are (1) the rapidly constricted spur and (2) large number of stipular glands.

25. **I. tripetala,** *Roxb.* var. **microscypha,** *Hook. f.;* Sinlum, Kachin Hills, 700 m., Aug., Sept. *Toppin* 2779.

An erect herb 30–45 cm. high. Stipular glands on each side of the leaf. *Flowers* bright light red-purple. *Bracts* at the base of the pedicel. *Capsule* turgid and entirely composed of thick glistening substance. *Seeds* brown in colour; average number found in 5 capsules 16 (9–24).

I examined 27 different plants and found no variation in (1) number of sepals (2) colour and size of the auricles, but I found great variation in the colour of the sepals, some being bright green and others of the same colour as the flower.

28. **I. chinensis,** *L.;* Fyson, Fl. Pulney Hills, ii. 49. Bot. Mag. t. 4631. N.E. Burma, Lweje at 1000 m., in the water-courses between the fields. *Toppin* 2780.

Except at the extremity, the spur is distinctly broad in most specimens. This is sometimes found with pure white flowers instead of the usual bright pink.

38a. **I. Pritchardii,** *Toppin;* species *I. laevigatae,* Wall., affinis, sed pubescentia coloreque florum distat.

Herba erecta, pubescentia, robusta, 8–10 cm. alta, cauli succulento. *Folia* ovato-lanceolata, acuminata, serrata, 10–13 cm. longa, alterna, in petiolum 4–5 cm. longum angustata, nervis utrinque 8–10; glandulae stipulares nullae. *Inflorescentia* pedunculata, pedunculis bifloris; pedicelli 1·5–2 cm. longi, inferiore basi, superiore altius bracteato; bracteae lanceolatae, 5 mm. longae. *Flores* expansi, ad 3 cm. diametro. *Sepala* lateralia 2, obliqua, ovato-acuminata, 1·2 cm. longa, 3-vel 5-nervia, fere alba; labelli limbus rubro-flavus, cymbiformis, in calcar incurvum 1·5 cm. longum attenuatus, ore 2 cm. longo horizontali. *Vexillum* orbiculare vel ellipticum, ad 1·5 cm. diametro, pubescens, purpureum; costa dorso carinata. *Alae* ad 3 cm. longae, purpureae; lobus basalis rotundatus, lobus distalis oblongus; auricula dorsalis conspicua. *Filamenta* 5 mm. longa. *Capsulae* turgidae, 3 cm. longae. *Semina* circa 15, fusca.

Kachin Hills, Wasi, at 170 m., in damp shady places, 12.12.1911. *Toppin* 4093.

(*See page* 360.)

40. **I. arguta,** *Hook. f. & Thoms.;* Hook. Ic. Pl. t. 2875 (var.). N.E. Burma at 800–1700 m. Lateral sepals and standard red, wings lilac, labellum mottled with the same colour and spur yellowish brown.

43. **I. Jurpia,** *Ham.;* Kachin Hills, Sinlum, at 2170–2300 m. Only found in very wet and absolutely shady places. Aug. and Sept. *Toppin* 2745.

A very stout and erect herb 1–1·2 m. high. Stipular glands nil. *Bracts* green, half way up the pedicels. *Flower* white, flushed with rose and spotted with a deeper shade. *Sepals* 2, pure white in colour. *Wings* divergent, forming a well-defined open mouth. This is the finest balsam seen up to date.

43. **I. rubrolineata,** *Hook. f.;* N.E. Burma. Common in the Kachin country towards Kampti Long and further East in the Khunnong area, Kumtat 500 m. Naogang 500 m., Nja Hka 430 m. January. *Toppin* 4300, 6034.

(*See page* 361.)

I. Pritchardii, Toppin—Fig. 1, lateral sepal; 2, spurred sepal; 3, standard; 4, wing.

I. rubrolineata, Hook. f.—Fig. 1, lateral sepal; 2, spurred sepal; 3, standard; 4 wing. (Interior sepals not shown.)

A stout erect glabrous plant 0·6–1 m. high. *Leaves* alternate, ovate-lanceolate, glabrous and dark green. Stipules and stipular glands nil. Petioles 2–3 cm. in length with 3 or 4 pairs of glands. *Pedicels* in whorls of 5 or 6, springing from a common peduncle which arises from the upper leaf axils. Length of the pedicels 1–2 cm. Length of peduncles 5 cm. *Bracts* ovate or ovate-lanceolate, at the base of the pedicels. *Flower* light lemon, striated with pink and sometimes with a few dark green blotches on the standard. *Sepals* 4, the exterior ovate, the interior very elongate, 2 cm. long and nearly colourless, with a peculiar hook-like process at the apex. *Lip* broadly open. *Spur* blunt, curved. *Wings* 4 cm. long; dorsal auricles well developed; lobes large. *Standard* with a characteristic large blunt keel. *Pod* glabrous, elongate and only containing seeds in the upper half, 4–5 cm. in length. *Seeds* glabrous; average number in 18 pods examined 5·8 (3–7).

This plant may later have to be separated from *I. rubrolineata*, Hook. f. There is no dried specimen of the plant at Kew, but only a drawing of an incomplete specimen collected at Manipur. This drawing does not show the most distinctive hook-like process on the interior sepal which is characteristic of the specimens described above, but the plant agrees roughly in other respects with the description in *Kew Bull.* 1910, 300. The plant, however, there described has exterior sepals 1·5 cm. in length instead of 1·1–1·2 cm. and also oblique in form. Also "costa dorso breviter cristata" hardly describes the standard of the present plant which is perhaps "costa dorso supra medium ample cristata." The specimen quoted in the *Kew Bulletin* consists of only one sheet in very poor condition, and the hook-like process may have been torn off or not have been evident in dissection.

43b. **I. cymbifera,** *Hook. f.;* Kachin Hills, Sinlum. In damp shady places by the side of the streams at 1700–1800 m. in Aug. and Sept. *Toppin* 2777.

I. cymbifera, Hook. f.—Fig. 1, part of inflorescence; 2, flower; 3, lateral sepal; 4, spurred sepal; 5, standard; 6, wing.

An erect glabrous, stout and branched *herb* 1–2 m. high. *Stem* groved, nodes prominent and sometimes rufous in colour. *Leaves* ovate-lanceolate, crenate, 10–13 cm. exclusive of the petiole which is 1·25–2·5 cm. long. Two stipular glands at the base of the petiole. *Racemes* simple, springing from the axils of the leaves, 10–13 cm. long; the pedicels 1–2 cm. in length, alternate from the peduncle. *Bracts* caducous, large, white, completely protecting the young flower. *Sepals* 2, ovate, cordate, acuminate, mauve in colour. *Corolla* 3·5 cm. in length, dirty mauve in colour, blotched with yellow and dark purple. *Standard* orbicular, without keel. *Wings* with lateral lobes rounded, the terminal narrow with no dilatation or depression on the margin. *Lip* with a slightly curved slender spur. *Pollen* pinkish-mauve in colour. *Capsule* linear. *Seeds* glabrous, average number found in 5 capsules 9·8.

Fertilised by bees. This is most interesting to me for it is the first species collected in these parts that has large caducous bracts that are of sufficient size to protect the flower while in bud, and it is a distinct link between the groups into which I have divided the majority of the genus in this range. It possesses the typical open mouth of the one group, while at the same time it has no auricular lobe and its capsule is clavate.

47a. **I. porphyrea,** *Toppin;* species *I. stenanthae,* Hook. f., affinis, sed bracteis persistentibus et floribus purpureis distincta.

Herba erecta, ramosa, glabra, 1–2 m. alta. *Caulis* in nodis turgidulus, striatus. *Folia* ovata vel lanceolata, 7–10 cm. longa, arcte crenata; petioli 0·5–1 cm. longi, basi duobus glandulis setiformibus stipularibus ornati. *Flores* 2·5 cm. longi, porphyrei, in racemis terminalibus vel rarius axillaribus pedunculatis ad 8 cm. longis dispositi; pedicelli ad 2 cm. longi, bracteis persistentibus concavis coloratis suffulti. *Sepala* lateralia lanceolata, 8 mm. longa, viridia vel colorata; posticum infundibuliforme, superne cornutum; calcar paullo curvatum, extremitata turgido. *Vexillum* orbiculare, obtuse calcaratum. *Alae* lobi laterales rotundati, terminales acutissime elongati margine integri. *Capsula* linearis.

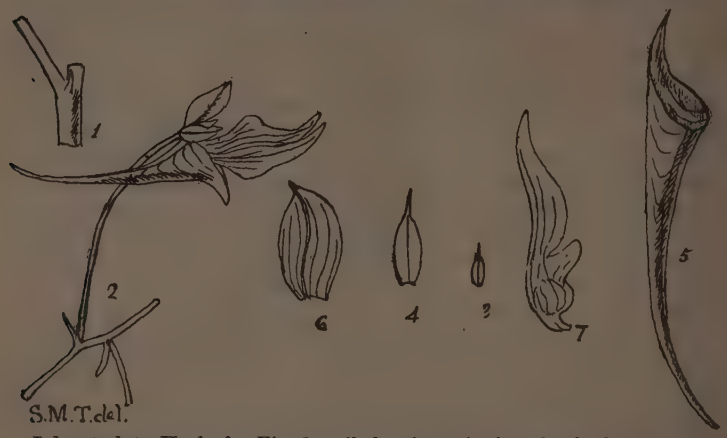
Kachin Hills. Sinlum; 2200–2300 m., in sunny situations near the top of one hill only, on which it grows in dense patches. *Toppin* 2744.

The colour of all plants seen was of the same deep claret colour. The mouth of the flower is closed by the convergent terminal lobes of the wings. Bees usually settle on the lip and pierce the extremity, thus robbing the honey.

48. **I. bracteolata,** *Hook. f.;* Hills East of Bhamo, 1500–2300 m. June to July, in sunny moist places and also along shady watercourses. This is the most widely spread species in these hills, *Toppin* 2678.

A slender erect glabrous and branched herb 1 m. high. *Stem* terete, swollen at the nodes and often coloured brown. *Leaves* ovate-lanceolate, crenate, 10–15 cm. long, exclusive of petiole. Petiole 1 cm. in length with two small stipular glands at base. *Racemes* simple, springing from the axils of the leaves, 10–12 cm.

long. The pedicels 2 cm. in length. Bracts persistent, small. *Flower* 4 cm. in length, light yellow in colour throughout, with



I. bracteolata, Hook. f.—Fig. 1, axil showing stipular gland; 2, part of inflorescence; 3, outer sepal; 4, inner sepal; 5, spurred sepal; 6, standard; 7, wing.

a very contorted appearance. *Sepals* 4, both pairs very small, but one very minute indeed with a dark red spot at the extremity. *Lip* with a long slender straight spur. *Standard* erect or even bent backwards and contorted on itself, not spurred. *Wings* with two narrow lobes, contorted so that the two wings cross each other, the terminal lobe having a pit-like depression on its margin instead of the dilatation. *Pollen* light yellow. *Capsule* linear. *Seeds* only at the apex, dark brown; average number found in 28 capsules examined was 11·8 (9–16).

The distinctive points of this plant are (1) the erect contorted standard, (2) the pit-like depression on the terminal lobes of the wings.

49. **I. drepanophora,** *Hook. f.;* Hills east of Bhamo at 1700–2300 m. Aug.–Sept. In shady places along the watercourses and roadsides. *Toppin* 2778.

I. drepanophora, Hook. f.—Fig. 1, part of inflorescence; 2, flower; 3, bract; 4, lateral sepal; 5, spurred sepal; 5, standard; 7, wing.

I. kachensis, Hook. f.—Fig. 1, lateral sepal; 2, spurred sepal; 3, standard; 4, wing.

A tall erect glabrous and branched herb 1–1·2 m. high. *Stem* terete, only slightly swollen at the light green nodes. *Leaves* ovate-lanceolate, crenate, 10–13 cm. long exclusive of petiole which is 5 cm. in length. Petiole with two small stipular glands at base. *Racemes* simple, springing from axils of the leaves, 10–15 cm. long, the pedicels 2 cm. in length. Bracts caducous, small, ovate-lanceolate, with apiculate tip, green in colour. Bud, excluding spur, ovoid in shape. *Flower* 3·5 cm. in length. Lateral *sepals* 2, uncinate, long awned, light green in colour. *Lip* with long spiral or corkscrew spur, spotted with crimson; the upper margin of the mouth of the lip has a peculiar light green horn. *Standard* yellow-orange in colour, slightly spurred. *Wings* with two narrow lobes slightly spotted with crimson, the terminal lobe having no dilatation or depression on its margin.

The distinctive points of this plant are: (1) the orange yellow colour with crimson spots, (2) the corkscrew shape of the spur, (3) the erect green horn on the upper margin of the mouth of the lip, (4) the uncinate awned sepals.

The mouth of the flower is closed by the convergent wings. It is visited by the bees, which often settle on the lip and prick the spur from the outside to rob the honey.

49a. **I. kachinensis,** *Hook. f.* MS.; Kachin Hills, Sumprang at 420 m.; Bum Kan at 470 m.; Kumtat at 480 m. in the shingle bed of streams which during the rains must be many feet under water.

(*See page* 365.)

A semi-erect plant. *Stem* red. Stipular glands red. *Flower* entirely light orange-yellow. Mouth closed by wings. *Wings* long, contorted, and with no auricular lobes. *Capsules* linear, the seeds being in the upper portion only. Seeds gibbous, average number in 16 capsules examined was 12·5 (7–17).

This species is visited at day by butterflies and bees. Auricular lobes if present would be of no avail as they would be hidden by the contorted wings. The flowers are small, as in *I. graciliflora*, Hook. f., and *I. drepanophora*, Hook. f., and many more, and the insect in actually forcing its way into the mouth is driven against the anthers.

EXTRACTS FROM LETTERS FROM SIR J. D. HOOKER TO MAJOR TOPPIN UPON THE SUBJECT OF HIS IMPATIENS COLLECTIONS.

The Camp,
near Sunningdale,
August 3, 1910.

My Dear Sir,

You are no doubt aware that Mrs. Toppin has submitted to my inspection the 5 species of Balsam collected by you in the N.W. Himalaya. To my great surprise I at once recognised 4 of those collected in Chitral, to be totally different from any of the upwards of 100 Himalayan kinds known to me. When to this is added the remarkable fact that these most distinct plants are confined to the extreme western limit of the genus in the

Himalaya, their discovery must be regarded as, in a geographic point of view, one of great and singular interest.

August 2, 1911.

In your last letter, 15-1-11, you tell me that you are going to take 3 months' leave this summer and propose confining your attention to a few genera. This will give you time to make careful notes on the plants which you will collect, and such notes will be invaluable.

October 5, 1911.

I have just received your long and very interesting letter from Bhamo, of 2-9-11, for which I most cordially thank you. I do wish I could discuss with you several of the very curious points it indicates, but at my age it is impossible, for I am in my 95th year.

I do fervently hope you will publish your *Impatiens* observations and send them to the *Kew Bulletin*. Above all, do keep the Kew Herbarium supplied with specimens of your discoveries, accompanied with flowers for analysis and your excellent notes. Thank you most truly for the correspondence you have given me, and with every good wish for your professional advancement and career,

Believe me, dear Mr. Toppin,

Most sincerely yours,

Jos. D. Hooker.

LVI.—MISCELLANEOUS NOTES.

Dr. A. F. G. Kerr, Government Medical Officer, Chiengmai, Siam, has been appointed Government Botanist in Siam.

Dr. Kerr has for some years devoted his leisure to a study of the flora of Siam and has sent to Kew extensive collections containing many new species which have been described in the *Kew Bulletin* in "Contributions to the Flora of Siam," by Prof. W. G. Craib. It is a matter for congratulation that Dr. Kerr has now been placed in a position to devote his whole time to the investigation of the comparatively little-known botanical resources of this region.

Mr. W. Small, M.B.E., appointed Botanist in the Department of Agriculture, Uganda, in 1913 (*K.B.*, 1913, 90), has now been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Mycologist in the same Department.

Mr. A. S. Clegg, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Agricultural Superintendent in Mauritius.

Mr. E. Downes, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, Assistant Superintendent of Public Gardens, Jamaica.

Mr. E. A. Ruck, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for the Colonies, on the recommendation of Kew, an Assistant District Agricultural Officer in the Department of Agriculture, Uganda.

Mr. E. A. Hughes, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for India in Council, on the recommendation of Kew, a gardener in the service of the Government of the Punjab.

Mr. G. H. Fothergill, a member of the gardening staff of the Royal Botanic Gardens, has been appointed by the Secretary of State for India in Council, on the recommendation of Kew, a gardener in the service of the Government of Bengal.

Mr. E. A. McCallan, First Agricultural Assistant, Department of Agriculture, Bermuda, has been appointed by the Secretary of State for the Colonies, Director of Agriculture, Bermuda, in succession to Mr. E. J. Wortley (*K.B.*, 1920, 285).

Mr. W. H. Johnson, lately Director of Agriculture, Southern Provinces, Nigeria, who has recently retired on pension from the Colonial Service, has accepted a commission from the Empire Cotton Growing Association to proceed to Queensland and other parts of Australia with reference to cotton growing in that country.

John Reader Jackson.—We record with great regret the death of Mr. J. R. Jackson on October 28th at Lympstone, S. Devon, in his 84th year. Since the year 1914 he had been in indifferent health, but had still been able to enjoy his well-earned rest and devote some time to the subject of Economic Botany in which he had a lifelong interest.

When Mr. Jackson retired from the post of Keeper of the Museums in 1901 a note was published in the *Kew Bulletin* for that year, on p. 201, giving a brief account of his work at Kew. Since his retirement from his official duties, after 43 years' devoted service, Mr. Jackson contributed many articles on Economic Botany to the "Technologist," the "Pharmaceutical Journal," "Gardeners' Chronicle" and other periodicals.

He was born at Knightsbridge in May, 1837, and then lived for several years at Canterbury, where his family went to reside when he was some six years old. The architectural interests of Canterbury appear to have influenced him very strongly and stimulated him with a desire to become an architect, but as this profession did not offer him the prospect of a lucrative position at

the moment he was advised by his friend Prof. Bell to divert his attention to other studies. It was through this friend that he was introduced to Sir William Hooker, Robert Brown, John Lindley, and other eminent men, and in the year 1858 he was put in charge of the Museums at Kew in succession to Alexander Smith, the first Curator.

The Kew Museum collections at that date were only in their earliest stages, and for twenty years Mr. Jackson remained in sole charge. Owing to the growing importance of the collections an assistant, Mr. J. M. Hillier, was appointed in 1879, Mr. Jackson being made Keeper, and on his retirement in 1901 he was succeeded as Keeper by Mr. Hillier.

Among his works may be mentioned the new edition of Barton and Castle's *British Flora Medica* which he edited in 1877, and the *Commercial Botany of the XIX Century* which was published in 1890.

One of his official duties at Kew was to give lectures on Economic Botany to the young gardeners, and the value of his courses of instruction and his keen interest in this work are gratefully remembered by some hundreds of Kewites.

During his long residence in Richmond Mr. Jackson was actively engaged in charitable and educational works connected with St. John's Church, of which he was for many years one of the Wardens. In 1868 Mr. Jackson was elected an Associate of the Linnean Society and at the time of his death was the oldest Associate.

His former colleagues retain the memory of a gentle and unselfish character and a valued friend.

Odoardo Beccari.—It is with very much regret that we have received the announcement of the death at Florence, on October 25th, of Dr. Odoardo Beccari, an old and highly esteemed correspondent of the establishment and a liberal contributor to the Herbarium. Since October, 1869, Kew has been in frequent communication with him, and up till February, 1918, he continued to send dried specimens and drawings, chiefly of Palms, and copies of certain of his publications for the library. For many years he was Director of the Royal Botanic Garden and Museum at Florence. His travels in Malaya and New Guinea during which he made large collections of botanical specimens, resulted in the publication, between the years 1877 and 1886, of three quarto volumes, under the title of "Malesia," each containing numerous plates. The second volume of this work includes Beccari's classical study on myrmecophilous plants. A letter from him, dated February 19th, 1888, conveys an acknowledgment of pecuniary help afforded him by the Bentham Trustees towards the cost of the illustrations in this work. A narrative of some portion of his travels appeared in 1902 under the title "Nelle Foreste di Borneo." An English translation of this volume, by Dr. E. H. Gigliolo, with some modifications, was published in London in 1904. For many years past Dr. Beccari devoted his studies chiefly to the Palmae, and published numerous works large and small on the family. Amongst these may

be mentioned "Palme del Madagascar" (1912), a large folio volume containing 50 plates, and "Asiatic Palms-Lepidocaryeae" (1908–14), published in the "Annals of the Royal Botanic Garden, Calcutta," vol. xi. and vol. xii. pt. 1; so far he had dealt with the species of *Calamus* and *Daemonorhops*, the former illustrated with 321 and the latter with 111 plates. He contributed several papers to the Italian botanical journals, the more important to "Webbia." Accompanied by Count Martelli, Dr. Beccari spent a few days at Kew in 1908, from July 27th to August 1st. He was elected a Foreign member of the Linnean Society on May 3rd, 1883, at the same time as the late Professor John Lange of Copenhagen. S. A. S.

Reginald Farrer.—Alpine plants and rock gardens have a wide circle of admirers. In this circle a prominent figure was Mr. Reginald John Farrer, the announcement of whose death we have received with profound regret. An enthusiast such as he really was cannot have failed to influence for good those who had come into personal relations with him or had read his books and other writings. Few knew alpines as he did. He had studied them for many years in their native haunts. He had a large-hearted love for all that was beautiful in plant life, and a teeming vocabulary in which to describe the forms and colours and homes of his favourites. Born forty years ago and a native of Yorkshire, as early as 1894 he gave some expression of that interest in alpine vegetation which in later years appeared so dominant by publishing a note in the "Journal of Botany" (p. 344) on the rare *Arenaria gothica*. This he had discovered in another station in the Ingleborough district, where alone it is known in Britain, other than that previously recorded. In 1898 he entered Balliol College, Oxford, as a Commoner. Subsequently he made several tours in the European Alps and published numerous articles on them and the plants he met with in the "Gardeners' Chronicle." These explorations also were the inspiration of the volume "Among the Hills," issued from the press in 1911. In 1903 he undertook a journey round the world, visiting among other places Canada, China and Japan. One outcome of the experiences thus gained was a lecture to the Royal Horticultural Society in May, 1905, on Japanese Plants and Gardens, published in the Society's Journal, vol. xxxi. pp. 12–17. He visited Ceylon in 1907, and spent the years 1914 and 1915 in exploring, in company with Mr. William Purdom, formerly of Kew, the Kansu region of Western China. His work "On the Eaves of the World," published in 1917, is a narrative, in something more than ordinary language, of his wanderings and experiences of the year 1914. A series of articles on his travels in China also appeared in the "Gardeners' Chronicle." Last year another journey to Eastern Asia was undertaken—a journey from which unhappily he was not destined to return, for he fell a victim to diphtheria on October 16th, while travelling on the frontier range between Burma and China. These journeys to the East led to the appearance in cultivation of a considerable

number of choice plants including many novelties. Among them may be mentioned representatives of the following genera, of which new species bear his name:—*Callianthemum, Isopyrum, Sedum, Lonicera, Aster, Primula, Buddleia, Gentiana, Isometrum*, a new genus of *Gesneraceae, Cypripedilum, Iris* and *Lilium*. He is also commemorated in *Farreria*, Balf. f. & W. W. Smith, a new genus of *Thymelaeaceae*. Most of the above and other new plants discovered by him are described in the "Notes from the Royal Botanic Garden, Edinburgh." Mr. Farrer's own descriptions of many of his plants appear in his "Report on work in 1914 in Kansu and Tibet" published in the "Journal of the Royal Horticultural Society," vol. xlii. pp. 47–114. In addition to works on fiction and those already specified Farrer wrote "My Rock Garden" (1907), "Alpines and Bog Plants" (1908), "In a Yorkshire Garden" (1909), "The Rock Garden" (Present-Day Gardening Series), and "The English Rock Garden," the last, consisting of over 1000 pages and 102 plates, published in 1919. Many of Mr. Farrer's introductions may be seen at Kew, and numerous others will no doubt yet appear in these and other gardens to procure which he made so many sacrifices, even the sacrifice of a life so largely abounding in those qualities and possessions that render it desirable and beautiful. Appreciations of Mr. Farrer, with a portrait, appear in the "Gardeners' Chronicle" of November 20th. S. A. S.

Miss M. L. Moxon's Alpine Flower Studies.—The collections of the Royal Botanic Gardens, Kew, have been enriched by a very valuable bequest by the late Miss Margaret Louisa Moxon, of the Hazels, New Milton, Hants, consisting of about 1000 water colour drawings of Swiss wild flowers painted during her many visits to Switzerland.

The collection is a remarkably representative series of studies of the flora of the Alps both of the high mountains and of the lower meadows and pastures. The drawings are executed with great artistic skill and scientific accuracy and each study is of great beauty. The collection is contained in seven large portfolios. In the case of the larger subjects only a single species is figured on a sheet but with the smaller plants from the high Alps three or more species may be represented on one sheet, but kept quite distinct and separate.

Some of the plants have been carefully named but owing to Miss Moxon's untimely death the exact determinations had not been completed, nor, unfortunately, had she fully achieved her object of painting the whole of the Swiss alpine flora.

The drawings will be placed in the Herbarium and kept as a separate collection available for study by students as soon as a catalogue has been completed.

Mr. A. E. Moxon, the only surviving brother of the artist, has very generously offered to help to defray the cost of preparing a catalogue; we are also indebted to him for the following particulars of his family and of Miss Moxon's life work.

"Margaret Louisa Moxon, the only daughter of James Edward

and Louisa Sarah Moxon, was born in London on Sept. 30th, 1863.

"There can be no doubt that she inherited her love of nature and talent for drawing from her Huguenot ancestors who after the Revocation of the Edict of Nantes fled to Norwich and settled there for many generations. It was not until 1904 that she paid her first visit to Switzerland, also visiting Italy and Sicily. While at Axenfels she was struck by the wealth of flowers on the alpine pastures but had never received any instruction in flower painting. She started a series of flower studies of that district and finding her interest growing began to make the collection now given to Kew.

"In 1907, 1912 and 1913 other trips were made in search of fresh subjects for her brush but it was always the higher alpines that interested her most. But for the outbreak of the war it was her intention to settle out there and make a complete collection of the Swiss flora. She always said the most difficult flower (Swiss) to paint was *Astrantia major*.

"She died on July 11th in her 57th year and was buried in Milton Churchyard."

Polypodiopsis, *Carrière.*—In his Traité Général des Conifères, ed. 2, p. 710 (1867), Carrière described as *Polypodiopsis Muellerii* what he took to be a new genus of *Coniferae*. This was duly recorded in the Index Kewensis, but otherwise appears to have been overlooked by systematic botanists, not being mentioned by either Bentham and Hooker or by Engler and Prantl. Even Pilger in his monograph of *Taxaceae* for the Pflanzenreich has taken no heed of it. The name is mentioned, however, by Coulter and Chamberlain in their Morphology of Gymnosperms, p. 313 (1910). In speaking of the distribution of Tribe *Taxineae* they remark "The New Caledonian representation is so small, and the affinities of *Polypodiopsis* are so uncertain, that the tribe may be regarded as northern in its distribution, in contrast with the southern distribution of the podocarps."

In reply to an enquiry from Kew, Professor H. Lecomte states that there is no trace of Carrière's specimen amongst the New Caledonian *Coniferae* preserved in the Paris Museum, and at the same time very kindly suggested that the specimen described by Carrière might be one of the *Proteaceae*. Following up this, I find amongst the New Caledonian *Proteaceae* one genus and species, *Bauprea Balansae*, Brongn. & Gris, which agrees exactly with Carrière's description. Carrière mentioned the general similarity of his *Polypodiopsis* with the genus *Phyllocladus*, a genuine member of the *Taxaceae*, and *Bauprea* shows this resemblance very closely. J. H.

Flora Capensis.—The issue of Parts II. and III. of the second section of Vol. V. of this work, edited by Sir W. T. Thiselton-Dyer, should be recorded. Part II. (pp. 193–384), which was issued in Oct. 1915, continues the analysis of

Santalaceae by Dr. A. W. Hill, which is followed by the *Balanophoraceae* by Mr. C. H. Wright. *Euphorbiaceae*, for which Sir D. Prain, Mr. N. E. Brown and Mr. J. Hutchinson are responsible, occupies the rest of this Part, and extends almost to the end of Part III. (pp. 385–528) which was published in May, 1920. Part III. also includes *Ulmaceae* and concludes with the 3rd species of *Ficus* in *Moraceae*.

Flora of Tropical Africa.—Since the last notice of this work appeared (*Kew Bull.* 1913, p. 283) six more parts have been published as follows:—

Vol. vi. Sect 2, pt. 1, pp. 1–192	(Mar. 1916).
,, ix. pt. 1, pp. 1–192	(Mar. 1917).
,, vi. Sect. 2, pt. 2, pp. 193–359	(Feb. 1918).
,, ix. pt. 2, pp. 193–384	(Apr. 1918).
,, ix. pt. 3, pp. 385–576	(July 1919).
,, ix. pt. 4, pp. 577–760	(July 1920).

Volume vi. Sect. 2, pts. 1 and 2, deals with the remainder of the *Monochlamydeae* and with the Gymnosperms, the following families being described:—*Ulmaceae*, **Barbeyaceae*, *Cannabinaceae* (by A. B. Rendle), *Moraceae* (by A. B. Rendle and J. Hutchinson), *Urticaceae* (by A. B. Rendle), *Myricaceae* (by J. Hutchinson), *Casuarineae* (by C. H. Wright), *Salicineae* and *Ceratophylleae* (by S. A. Skan), *Gnetaceae* (by H. H. W. Pearson), *Pinaceae* and *Taxaceae* (by O. Stapf), and the *Cycadaceae* (by D. Prain).

Vol. ix. pts. 1–4, deals with the *Gramineae* (by O. Stapf), of which there are 178 genera arranged in 19 tribes, the 75th genus, *Setaria*, being reached at the end of part four.

Botanical Magazine.—The following plants are figured in the numbers for July, August and September:—*Nuphar polysepalum*, Engelm. (t. 8852), from the mountain lakes of Colorado; *Pleurothallis grandis*, Rolfe (t. 8853), a native of Costa Rica; *Cotoneaster serotina*, Hutchinson (t. 8854), from Western China; *Daphne tangutica*, Maxim. (t. 8855), from Kansu, Western China; *Coelogyne integerrima*, Ames (t. 8856), a native of the Philippines; *Berberis atrocarpa*, C. K. Schneider (t. 8857), from Western Szechuan; *Allium sikkimense*, Baker (t. 8858), from Sikkim; *Sabia latifolia*, Rehd. & Wils. (t. 8859), from China; *Acacia spectabilis*, Cunn. & Benth. (t. 8860), a native of Eastern Australia; *Arisaema Fargesii*, Buchet (t. 8861), from Szechuan and *Stranvaesia salicifolia*, Hutchinson (t. 8862), from China.

Botanical Magazine.—The numbers for October, November and December, 1920, completing Vol. XVI. of the Fourth Series of the magazine contain the following illustrations:—*Verbascum*

* A new family established by Dr. Rendle on a peculiar North-east African and Arabian plant previously referred by Schweinfurth to the *Urticaceae*.

Blattaria, Linn. var. *grandiflorum*, Turrill (t. 8863), found in a cornfield in Lincolnshire; *Rhododendron strigillosum*, Franch. (t. 8864), from Western China; *Fritillaria pontica*, Wahlenb. (t. 8865), a native of the Orient; *Melaleuca Radula*, Lindl. (t. 8866), a native of Western Australia; *Kniphofia Snowdeni*, C. H. Wright (t. 8867), from Uganda; *Erica sessiliflora*, Linn. f. (t. 8868), a native of South Africa; *Syringa reflexa*, C. K. Schneider (t. 8869), from Central China; *Phlomis spectabilis*, Falc. ex Benth. (t. 8870), a native of the Western Himalaya, Afghanistan and Baluchistan; *Rhododendron Sargentianum*, Rehder & E. H. Wils. (t. 8871), from Szechuan, South-Western China; *Mesembryanthemum dichroum*, Rolfe (t. 8872), from South Africa; and *Odontoglossum Humeanum*, Reichb. f. (t. 8873), a native of Southern Mexico.

The volume is dedicated to the Rev. William Wilks, M.A., V.M.H., "To whose labour and care as Secretary for over three decades of the Royal Horticultural Society gardencraft everywhere is greatly beholden."

The publishers of the Botanical Magazine, who with great public spirit have continued to issue the work throughout the war, have at last felt it incumbent upon them to give very careful consideration to its position. With much reluctance they have come to realise that the continuance of the work is dependent on its paying its footing all round. This it is not able to do. They have therefore resolved to terminate the Fourth Series of the Botanical Magazine with the present volume, and before committing themselves further, to ascertain in some way whether the Magazine is really worth continuing, and if so under what conditions it might be possible to do so.

Flowering Plants of South Africa.—The publication of the first number of "The Flowering Plants of South Africa" marks yet another phase of the work which comes under the scope of the Botanical Survey of the Union, the Director of which movement, Dr. I. B. Pole-Evans, has edited the work in question. The magazine, which contains hand-coloured figures with descriptions of the Flowering Plants indigenous to South Africa, and which is modelled on Curtis's *Botanical Magazine*, has as its object the fostering of interest of South Africans in the form and cultivation of their native plants. It is trusted that the work will appeal to a large public and that its circulation will be long-lived. It might be suggested, especially in view of the misleading effect which occurs on plates 3 and 4, that the omission of names on the plates themselves would be an improvement to the magazine.

The Bahama Flora.—A copy of their recently published volume entitled The Bahama Flora has been presented to Kew by Doctors N. L. Britton and C. H. Millspaugh. The work extends to nearly 700 pages, and includes not only the flowering plants and ferns but also the whole of the cellular Cryptogams, with a

total of 1952 species, of which 185, or rather under a tenth, are estimated as endemic. The flowering plants are naturally the best known, and of these 133 out of 995 are not yet known from elsewhere. Not one of 33 known ferns is peculiar to the islands, and only one out of 69 Bryophyta. In each case the distribution outside the Bahamas is briefly indicated. Cultivated species have been excluded except such as appear to have become spontaneous. The Bahamas form an archipelago of 29 islands and an enormous number of cays and isolated rocks, with a total land area of 4424 square miles, the total length being about 600 miles. The surface is mostly low, hilly and rocky, the hill ranges usually running lengthwise of the islands, and the highest hardly exceeding 200 ft. Mangrove swamps are local along the coastal lines, and there are no fresh water streams, but fresh water marshes exist on some of the larger islands. There are extensive forests of the Caribbean Pine (*Pinus caribaea*), on a few of the larger islands, also some hardwood forests (coppices), like the "hammocks" of southern Florida, and these are made up of a considerable variety of tall tree species, with a number of shrubs and low trees on the "Scrub-lands." The relationships of the native flora are with those of Florida, Cuba and Hispaniola, and it is assumed that the species which are in common have been transported from one or another of the land masses by natural agencies of winds, migratory birds or oceanic currents. The work contains a brief introduction, an account of the Explorations and Collections of the Bahamas—beginning with Thomas Walker, Chief Justice for the Bahama Plantation, who sent plants from New Providence to Mr. James Petiver, in London early in the eighteenth century—a Bibliography of works and papers relating to the Flora of the Bahamas, and a comprehensive Index. A great amount of attention has been paid to the Bahamas during recent years, and the work forms an important contribution to the history of the islands. R. A. R.

The Hardwoods of Australia and their Economics.*—The terms "hardwoods" and "softwoods" as applied to timbers in general are out of date and misleading, for they are not given by reason of the species included in each group possessing certain degrees of hardness, but are used to distinguish dicotyledonous and coniferous trees, and it would be advantageous if these terms could be so changed that the woods now known as "softwoods" should in future be called "conifers" and those known as "hardwoods" altered to "dicotyledons." The absurdity of the terms as at present applied is very pronounced, for some of the softest known woods such as *Ochroma*, *Erythrina*, and *Eriodendron*, are included amongst hardwoods, whilst *Callitris*, *Tetra-*

* The Hardwoods of Australia and their Economics, pp. xvi, 522, with 137 coloured and 194 black-and-white plates. By Richard T. Baker, F.L.S., Curator and Economic Botanist, Technological Museum, Sydney. Published by authority of the Government of the State of New South Wales. Obtainable from the Government Printer, Sydney, and from Messrs. Kegan Paul, Trench, Trübner & Co., 68, Carter Lane, Ludgate Hill, London, E.C. 4. Boards 25s., paper 22s. 6d. net.

clinis, and other hard coniferous woods are graded with soft-woods. In the preparation of the work under review, Mr. Baker has been faced with this difficulty, and he has commenced breaking down the distinction by including *Callitris* amongst Australian hardwoods. The work is in every way excellent, and it forms a valuable aid to the identification of the more important Australian timbers. It is divided into three parts. Part i. deals with the physical properties of timbers, and a good deal of attention is devoted to the colour of newly-worked wood as a means of identification. Mr. Baker has made a special study of this character, and upwards of 250 species are graded under the colours dark red, red, pink, grey, chocolate, yellow, pale, and white, whilst there are numerous coloured photographs of the wood of the more important species. In this section he also gives an account of the anatomy of wood. An interesting table is that devoted to the comparative combustibility of timbers. Of 117 kinds enumerated the best fire resisters are *Eucalyptus Fletcheri* and *Syncarpia laurifolia*. Compared with British Oak the resistance is nearly eight and five times respectively. Part ii. is devoted to descriptions of woods, the genera being arranged in botanical sequence in their respective families. The notices of the important woods commence with a general description of the timber and its uses, followed by particulars of its hardness, grade and weight. Then come the results of strength tests, followed by the anatomical features, and concluded with a systematic description of the tree and its geographical range. These descriptions, with the necessary plates and micro-photographs, occupy some 354 pages ended with lists of the various trees in their different degrees of hardness under the headings extremely hard, very hard, hard, and moderate. The species of the difficult genus *Eucalyptus* have been grouped under the headings Bloodwoods, Mahoganies, Boxes, Tallowwoods, Stringybarks, Woollybutts, Gums, Peppermints, Ashes, and Ironbarks. The different groups are distinguishable by the bark, and coloured photographs are given of the bark of each group. The third part is devoted to technical articles upon such subjects as nomenclature, seasoning, wood preservation and uses. The uses of Australian timbers are demonstrated by numerous photographs of constructive work, furniture, panelling, carving, etc. Mr. Baker is anxious that something should be done to limit the use of common names for timber, and suggests that greater use should be made of scientific names, particularly specific names in large genera. He informs us that this is already an accomplished fact in the essential oil industry of Australia and that it works well. The whole work is concluded with a very good index. W. D.

The Nature-Study of Plants*.—This book is divided into two parts, of which the first forms a general introduction to the study of plant-life and the second deals in detail with the life-history of the Herb Robert (*Geranium Robertianum*).

* The Nature-Study of Plants. By T. A. Dymes, F.L.S. London: Society for Promoting Christian Knowledge, 1920; pp. 173; 53 illustrations; price 6s.

The underlying idea throughout the book is comparison of the phenomena of plant-life with those of human-life. While the text is certainly written in a way to stimulate the curiosity of the reader and induce him to find out things for himself, the standpoint taken is frankly teleological and vitalistic, and such phrases as "the Scheme of Creation" frequently recur. The work should be useful to teachers of Nature Study and suggestive to "Hobby-Botanists," for whom it is primarily written. It is a pity that some of the figures are not more worthy of the text. W. B. T.

Trees for the Falkland Islands.—Owing to representations made from time to time to the Colonial Office respecting the desirability of experimenting with the cultivation of forest and other trees in the Falkland Islands, and notably from the interest taken in the matter by Major F. R. St. Johnston, lately Colonial Secretary in the Islands, the advice of the Director of the Royal Botanic Gardens, Kew, was sought on the subject in 1919. Under his direction an account of the various efforts made in the past to establish forest trees in the Islands was compiled, and this, together with the recommendations made to the Colonial Office, was published in *K.B.*, 1919, pp. 209–217. In the experimental scheme presented, a recommendation was made that a man skilled in forestry matters, capable of carrying out experiments and instructing the islanders, should be sent out to control any attempt that might be made to establish plantations, and that a fairly wide selection of species should be tried.

During the spring and summer of 1920, further correspondence took place between Major St. Johnston, the newly appointed Governor of the Falkland Islands, Mr. J. Middleton, C.M.G., the Colonial Office, and the Royal Botanic Gardens. Further, advantage was taken of the presence of the Governor in London to discuss the matter in all its bearings. These deliberations resulted in the appointment of Mr. James Reid, a student Forester from the Royal Botanic Gardens, Edinburgh, who had previously had several years experience in forests in Scotland, to the post of Forest Officer in the Falkland Islands (*K.B.*, 1920, p. 286). He sailed on November 24th, and took out with him a consignment of young trees procured from Messrs. Dicksons, of Chester, with various seeds and cuttings from Kew.

As the experiment is likely to prove of more than ordinary interest permission has been obtained from the Colonial Office to publish the list of plants and cuttings sent out.

Plants supplied by Messrs. Dicksons:—

Alnus glutinosa, 1½–2 ft. ...	2,000	*Picea sitchensis*, 6–9 in. ...	2,000
,, *incana*, seedlings ...	1,000	,, *excelsa*, 6–9 in. ...	2,000
Fraxinus excelsior, 2-year seedlings	1,000	*Acer Pseudoplatanus*, 1-year seedlings	2,000
Pyrus Aucuparia, 1–2 ft. ...	500	*Betula alba*, 2-year seedlings	2,000
Pinus Laricio, 6–12 in. ...	1,000	*Ulmus campestris*, 1½–2 ft.	1,000
— var. *nigricans*, 6–12 in.	500	,, *montana*, 1½–2 ft. ...	1,000
Pinus sylvestris, 6–9 in. ...	2,000	*Populus serotina*, 1½–2 ft. ...	1,000

Seeds of Scots Pine, Corsican Pine, Sitka Spruce, and Common Spruce to be sent at a later date.

Cuttings from Kew:—

Populus trichocarpa.
„ *Eugenii.*
„ *serotina.*
„ *marylandica.*
„ *canescens.*
„ *generosa.*
„ *nigra.*
Salix fragilis.
Salix alba.
„ *daphnoides.*
„ *purpurea.*
„ *rubra.*
„ *triandra.*
„ *caerulea.*
„ *Smithiana.*

Seeds from Kew:—

Acer Pseudoplatanus.
Alnus glutinosa.
„ *incana.*
„ *firma.*
Betula alba.
„ *papyrifera.*
Carpinus Betulus.
Cotoneaster bacillaris.
Fraxinus excelsior.
Laburnum alpinum.
„ *vulgare.*
Quercus Cerris.
„ *pedunculata.*

The following seeds were sent from Kew in May, 1919, in response to the request of Major St. Johnston, when he was Colonial Secretary:—

Alnus cordifolia.
„ *firma.*
„ *incana.*
Berberis Aquifolium.
„ *Darwinii.*
Betula lutea.
„ *Maximowiczii.*
„ *occidentalis.*
„ *papyrifera.*
Caragana arborescens.
Cornus alba.
„ *Mas.*
„ *officinalis.*
„ *sanguinea.*
Cupressus Lawsoniana.
Cytisus scoparius.
— var. *Andreanus.*
Fraxinus oregona.
„ *pennsylvanica?*
Genista virgata.
Pyrus Aucuparia.
— var. *moravica.*
Pyrus pinnatifida.
„ *prunifolia.*
„ *rotundifolia.*
Rosa sericea.
„ *Soulieana.*
Spartium junceum.
Thuya plicata.

On learning from the *Kew Bulletin* article that an organised attempt was to be made to establish plantations of trees in the Islands, Mr. B. C. Aston, Secretary of the New Zealand Institute, suggested that the present might be a favourable opportunity to undertake an experiment with New Zealand Flax (*Phormium tenax*), in the Falklands. In response to a request from Kew, Mr. J. A. A. Wallace, of Lochryan, Stranraer, very kindly sent twelve seedling plants four years old, and twelve seedling plants two years old, and a packet of seed, which have been sent out with the trees and cuttings in charge of the Forest Officer.

Care was taken that all the plants and cuttings were free from insect pests. W. D.

INDEX.

A.

Abraham's Oak (with plate), 257.
— — , age of, 258.
Acacia spectabilis, 373.
Acanthophyllum Burkilli, *Drummond et Dunn*, 245.
Acer Garrettii, *Craib*, 301.
Acmadenia teretifolia, *Phillips*, 23.
— — var. glabrata, *Phillips*, 23.
Aeschynanthus Monetaria, *Dunn*, 135.
Agapetes marginata, *Dunn*, 133.
— nutans, *Dunn*, 134.
Agricultural College, tropical, in West Indies, 81.
Allium sikkimense, 373.
Aloe specimens from Pretoria, 138.
Aloes, South African, 138.
— — — , cultivated at Kew, 138.
Alsine or Stellaria, 308.
Amoora spectabilis and A. Wallichii, 238.
Amphichromy in heather, 221.
Andrachne emicans, *Dunn*, 210.
Angraecum Bolusii, *Rolfe*, 131.
— Hislopii, *Rolfe*, 130.
Appointments:—
Auchinleck, G. G., 136.
Besant, J., 286.
Clegg, A. S., 367.
Craib, Prof. W. G., 112.
Downes, E., 368.
Fothergill, G. H., 368.
Hall, F. W., 136.
Harcourt, F. G., 219.
Harris, W., 218.
Hughes, E. A., 368.
Jack, H. W., 219.
Kerr, Dr. A. F. G., 367.
McCall, J. S. J., 286.
McCallan, E. A., 368.
McDonald, Capt. J., 219.
Marshall, Capt. N., 136.
Mason, T. G., 218.
Matthews, C., 286.
Milsum, J. N., 219.
Nowell, W., 218.
Philpott, G. T., 136.
Reid, J., 286.
Rogers, F. M., 286.
Ruck, E. A., 368.
Small, W., 367.
Vardy, M., 71.
Wickham, Major R. T., 219.
Wortley, E. J., 285.
Araucaria imbricata at Bicton, 272.
Arceuthobium Oxycedri and its distribution, 264.
Argentina, botanical exploration in, 57, 223.
Arisaema Fargesii, 373.
Arundinaria Murielae, *Gamble*, 344.
Arundinella intricata, *Hughes*, 112.
Aspidopterys Hutchinsonii, *Haines*, 56.
Asteropyrum, *Drummond et Hutchinson*, gen. nov. (with fig.), 155.
— Cavaleriei, *Drummond et Hutchinson*, 156.
— peltatum, *Drummond et Hutchinson* (with fig.), 155.
Asystasia amoena, *Turrill*, 26.
Atraphaxis Billardieri, 255.
Auchinleck, G. G., 136.
Australia, Hardwoods of, 375.

B.

Bahama Flora, 374.
Baikiaea insignis, 255.
Baker, J. G., 319.
Balsams of Chitral and the Kachin Hills, notes on (with figs.), 345.
Bamboos and boring beetles, 282.
Beccari, O., 369.
Begonia aborensis, *Dunn*, 109.
— Burkilli, *Dunn*, 110.
— iridescens, *Dunn*, 110.
— scintillans, *Dunn*, 111.
Berberis atrocarpa, 373.
— Osmastonii, *Dunn*, 335.
Berteroa incana, var. stricta, *Turrill*, 181.
Besant, J. W., 286.
Bicton, arboretum and pinetum at, 268.
Biochemistry, practical plant, 288.
Bobartia Keetii, *Phillips*, 335.
Bocconia, revision of, 275.
— arborea (with fig.), 277.
— glaucifolia, *Hutchinson*, 281.
— gracilis, *Hutchinson*, 281.
— Pearcei, *Hutchinson*, 278.
— pubibracteata, *Hutchinson*, 279.
Bolusia rhodesiana, *Corbishley*, 329.
Books:—
Bahama Flora, 374.
Botanical Magazine, 255, 287, 373.
Compendium Florae Germaniae, 72.
Economic woods of the United States, 75.
Flora arabica, 74.
— Capensis, 372.
— of Jamaica, 224.
— — Madras, 75.
— — Sweden, 74.
— — Tropical Africa, 373.
— — Uitenhage and Port Elizabeth, 139.

Books—*cont.*
Flowering Plants of South Africa, 374.
Forests, Woods and Trees, 142.
French Forests and Forestry, 143.
Hardwoods of Australia, 375.
Journal of Pomology, 77.
Joseph Dalton Hooker, 287.
Kew Library Catalogue, 256.
Memoirs of the Botanical Survey of South Africa, 139.
Nature-Study of Plants, 376.
New Zealand plants and their story, 254.
Practical Plant Biochemistry, 288.
Science and Fruit Growing, 77.
Wheat in East Africa, 78.
Botanical exploration in Chile and Argentina, 57, 223.
— Magazine, 255, 287, 373.
Brassaiopsis magnifica, *Dunn*, 132.
Brazil wood, 79.
Braziletto, 79.
Brownleea Fanniniae, *Rolfe*, 131.
Buddleia candida, *Dunn*, 134.
Buettneria siamensis, *Craib*, 300.
Bulbophyllum macrobulbum, 287.

C.

Campanula sulphurea, 255.
Camphor seed, germination of, 45.
Caragana Hoplites, *Dunn*, 338.
Cardamine praténsis β uniflora in Britain, 223.
Carex riparia, var. gracilis in Britain, 141.
Carnations, a wilt of (with fig.), 321.
Centratherum Rangacharii, *Gamble*, 338.
Chaetochloa or Setaria? 124.
Chile, botanical exploration in, 57, 223.
Chitral, notes on the Balsams of (with figs.), 345.
Cladrastis Wilsonii, 119.
Clegg, A. S., 367.
Clematopsis (with figs.), 13.
— argentea, *Hutchinson*, 19.
— chrysocarpa, *Hutchinson*, 18.
— katangensis, *Hutchinson*, 19.
— Kirkii, *Hutchinson*, 17.
— oligophylla, *Hutchinson* (with fig.), 22.
— Oliveri, *Hutchinson*, 20
— scabiosifolia, *Hutchinson*, 20.
— speciosa, *Hutchinson* (with fig.), 18.
— Stanleyi, *Hutchinson* (with fig.), 21.
— Stuhlmannii, *Hutchinson*, 20.
Clematopsis Teuczii, *Hutchinson*, 17.
— trifida, *Hutchinson* (with fig.), 20.
— villosa, *Hutchinson*, 22.
Coconut, dwarf, 255.
Coelogyne integerrima, 373.
Coffea crassifolia, *Gamble*, 248.
Columbia Winitii, *Craib*, 301.
Compendium Florae Germaniae, 72.
Cornus Kousa, 287.
Cosmos, a wilt of, 321.
Cotoneaster serotina, 373
Cotton, West Indian leaf mildew of, 235.
Cotyledon oppositifolia, 255.
Craib, Prof. W. G., 112.
Craterispermum caudatum, *Hutchinson*, 23.

D.

Daphne tangutica, 373.
De Candolle, A., 219.
Decades Kewenses, 66, 108, 132, 205, 245, 335.
Delphinium, a wilt of (with figs.), 321.
Diseases of plants:—
Bud rot of oil palm, 307.
Carnations, a wilt of (with figs.), 321.
Cosmos, a wilt of, 321.
Cotton, West Indian leaf mildew of, 235.
Delphinium, a wilt of (with figs.), 321.
Ganoderma sp. on Oil palm (with plate), 306.
Nigella, a wilt of (with figs.), 321.
Oil palm, diseases of (with plate), 306.
Sclerotium Rolfsii on Carnations, 321.
Diagnoses Africanae, 23, 329.
Diospyros Collinsae, *Craib*, 302.
— impressa, *Dunn et R. Williams*, 342.
— similis, *Craib*, 303.
— viridis, *Craib*, 303.
Dioticarpus, *Dunn*, gen. nov., 337.
— Barryi, *Dunn*, 337.
Downes, E., 368.

E.

East Africa, wheat in, 78.
Economic woods of the United States, 75.
Elaeis guineensis, 199, 306.
Elatostema arcuana, *Dunn*, 209.
— imbricans, *Dunn*, 209.
— MacIntyrei, *Dunn*, 210.

Enemion, revision of, 159.
— biternatum (with fig.), 160.
— Hallii, *Drummond et Hutchinson*, 161.
— occidentale, *Drummond at Hutchinson*, 160.
— — var. coloratum, *Drummond et Hutchinson*, 160.
— Raddeanum (with fig.), 160.
— stipitatum, *Drummond et Hutchinson*, 160.
Erica Haroldiana, 287.
— sessiliflora, 374.
Erysimum Melicentae, *Dunn*, 336.
Eugenia aborensis, *Dunn*, 109.
Eulophia Boltonii, *Harv. et Rolfe*, 128.
— Huttonii, *Rolfe*, 128.
Euonymus alatus, 255.

F.

Falkland Islands, trees for, 377.
Farrer, R., 370.
Flora arabica, 74.
— Capensis, 372.
— of Bahamas, 374.
— — Jamaica, 224.
— — Macedonia, contributions to, 177.
— — Madras, 75.
— — — notes on, 49.
— — Siam, contributions to, 300.
— — Sweden, 74.
— — Tropical Africa, 373.
— — Uitenhage and Port Elizabeth, 139.
Flowering Plants of South Africa, 374.
Forests and Forestry, French, 143.
— , Woods and Trees, 142.
Fothergill, G. H., 368.
Fritillaria pontica, 374.
Fruit-growing and Science, 77.
Fungi exotici, 289.

G.

Gamble, J. S., flowering of Phyllostachys aurea, 217.
— — , Indian species of Mimosa (with figs.), 1.
— — , notes on Flora of Madras, 49.
Gaultheria cuneata, 255.
Ginkgo, fruiting of, at Kew (with fig.), 47.
Gomphostemma aborensis, *Dunn*, 135.

H.

Haematoxylon Brasiletto, 79.
Haines, H. H., Amoora spectabilis and A. Wallichii, 238.
Hall, F. W., 136.
Hanbury, Lady, 286.
Harcourt, F. G., 219.
Hardwoods of Australia, 375.
Harris, W., 218.
Haworthia Chalwini, 255.
Heather, amphichromy in, 221.
Helchrysum perlanigerum, *Gamble*, 341.
Hevea brasiliensis, selection of, 113.
Hoheria populnea, var. lancelata, 287.
Holmskioldia speciosa, *Hutchinson et Corbishley* (with fig.), 332.
Hooker, Sir J. D., 287.
Hoya burmanica, *Rolfe*, 343.
Hughes, E. A., 368.
Hymenocardia capensis, *Hutchinson*, 334.

I.

Ilex verticillata, 287.
Impatiens of Chitral and the Kachin Hills, notes on (with figs.), 345.
— annulifer (with figs.), 356.
— Bectari, *Hook f.*, 246.
— brachycentra (with figs.), 349.
— bracteolata (with figs.), 363.
— burmanica (with figs.), 357.
— cymbifera (with figs.), 362.
— delicata, *Toppin* (with figs.), 350.
— drepanophora (with figs.), 364.
— Edgworthii, var. Toppinii, *Hook f.* (with figs.), 348.
— erubescens, *Dunn* (with figs.), 350.
— kachinensis (with figs.), 365.
— kamtilongensis, *Toppin* (with figs.), 355.
— Lemanni (with figs.), 348.
— porphyrea, *Toppin*, 363.
— porrecta (with figs.), 352.
— Pritchardii, *Toppin* (with figs.), 359.
— pulchra (with figs.), 349.
— Roylei (with figs.), 347.
— rubrolineata (with figs.), 359.
— Toppinii, *Dunn* (with figs.), 353.
— tripetala (with figs.), 358.
— violaeflora (with figs.), 352.
Indigofera cedrorum, *Dunn*, 337.
Iris Hoogiana, 287.
Isachne angusta, *Stapf*, 28.
Isopyrum, revision of, 145.
— adiantifolium (with fig.), 164.
— auriculatum (with fig.), 164.
— Dalzielii, *Drummond et Hutchinson*, 163.
— Fargesii (with fig.), 165.
— sutchuenense (with fig.), 164.
— thalictrioides (with fig.), 161.
— trachyspermum (with fig.), 163.

Ixora Lawsoni, *Gamble*, 247.
— monticola, *Gamble*, 246.
— Saulierei, *Gamble*, 247.

J.

Jack, H. W., 219.
Jackson, J. R., 368.
Jamaica, Flora of, 224.
Jasminum Parkeri, *Dunn*, 69.
Jeffersonia and Plagiorhegma (with figs.), 242.
Johnson, W. H., 368.
Journal of Pomology, 77.

K.

Kachin Hills, notes on the Balsams of (with figs.), 345.
Kerr, Dr. A. F. G., 367.
Kew:—
Arboretum, 36.
Gardens, additions to, 38.
Herbarium, additions to, 43, 371.
Jodrell laboratory, research in, 39.
Library catalogue, supplement, 256.
— presentations to, 39.
Moxon, Miss M. L., alpine flower studies, 371.
Museums, 37.
— presentations to, 38.
Wild fauna and flora, additions to, 212.
Kniphofia Snowdeni, 374.
Knoxia linearis, *Gamble*, 68.
Knysna, a trip to, 225.

L.

Lasianthus cinereus, *Gamble*, 249.
Lasiococca Comberi, *Haines*, 70.
Leea pallida, *Craib*, 302.
Leptodermis Parkeri, *Dunn*, 206.
Leptopyrum, revision of, 159.
— fumarioides (with fig.), 159.
Leucadendron uniflorum, *Phillips*, 26.
Lilium Farreri, 287.
Lima wood, 79.
Linnean garden at Upsala, 221.
Lissochilus Rehmannii, *Rolfe*, 128.
— transvaalensis, *Rolfe*, 129.
Loder, Sir E. G., 175.

M.

McCall, J. S. J., 285.
McCallan, E. A., 368.
McDonald, Capt. J., 219.
Macedonia, contributions to the flora of, 177.
MacGregor, Sir William, 31.
Macleaya cordata (with fig.), 282.
— microcarpa (with fig.), 282.
Macrozanonia macrocarpa, 197.
Madras, Flora of, 75.
— , notes on Flora of, 49.
Magnolia conspicua, var. purpurascens, 119.
— Dawsoniana, 120.
— Nicholsoniana, 120.
— Sargentiana, 121.
— Wilsonii, 121.
Mairea felicioides, *Hutchinson et Corbishley*, 329.
Malus toringoides, *Hughes* (with figs.), 205.
— transitoria (with figs.), 206.
Marshall, Capt. N., 136.
Mason, T. G., 218.
Matthews, C., 286
Melaleuca Radula, 374.
Mesembryanthemum dichroum, 374.
Metrosideros collina, 287.
Mimosa, Indian species of, 1.
— Barberi, *Gamble* (with fig.), 5.
— hamata (with fig.), 3.
— himalayana, *Gamble* (with fig.), 4.
— polyancistra (with fig.), 3.
— Prainiana, *Gamble* (with fig.), 5.
— pudica (with fig.), 1.
— rubicaulis (with fig.), 1.
Mimusops Macaulayae, *Hutchinson et Corbishley* (with fig.), 329.
— spiculosa, *Hutchinson et Corbishley*, 331.
— umbraculigera, *Hutchinson et Corbishley*, 331.
Miliusa dolichantha, *Craib*, 108.
Milsum, J. N., 219.
Miscellaneous notes, 31, 71, 112, 136, 175, 218, 250, 285, 319, 367.
Momordica cochinchinensis, 6.
Moore, J. C., 250.
Morinda reticulata, *Gamble*, 248.
Mostuea amabilis, *Turrill*, 25.
Moxon, Miss M. L., alpine flower studies, 371.

N.

Nature-Study of Plants, 376.
New or rare trees and shrubs, 119.
— orchids, 128.
— Zealand Flax in Falkland Islands, 378.
— —, plants and their story, 254.
Nigella, a wilt of (with figs.), 321.
Nowell, W., 218.
Nuphar polysepalum, 373.

O.

Oak, Abraham's (with plate), 257.
— — , age of, 258.
Obituary notices:—
Baker, J. G., 319.
Beccari, O., 369.

Obituary notices—*cont.*
De Candolle, A., 219.
Farrer, R., 370.
Hanbury, Lady, 286.
Jackson, J. R., 368.
Loder, Sir E. G., 175.
MacGregor, Sir William, 31.
Moore, J. C., 250.
Perez, Dr. G. V., 175.
Powell, H., 220.
Tutcher, W. J., 136.
Tyson, W., 176.
Wilson, Dr. J. H., 71.
Odontoglossum Humeanum, 374.
Oil palm, West African, 199.
— — — — , diseases of (with plate), 306.
Oldenlandia anamalayana, *Gamble*, 67.
— Barberi, *Gamble*, 68.
Ophiorhiza heterostyla, *Dunn*, 133.
Orchids, new, 128.
Ovulariopsis Gossypii, *Wakef.* (with figs.), 237.
— obclavata, *Wakef.* (with figs.), 238.

P.

Para rubber trees, selection of, 113.
Paraquilegia, *Drummond et Hutchinson*, gen. nov., 156.
— caespitosa, *Drummond et Hutchinson*, 158.
— grandiflora, *Drummond et Hutchinson*, 156.
— microphylla, *Drummond et Hutchinson* (with fig.), 157.
— uniflora, *Drummond et Hutchinson*, 158.
Pavetta abyssinica, 287.
Peach wood, 79.
Perez, Dr. G. V., 175.
Phalaenopsis latisepala, *Rolfe*, 130.
— Micholitzii, *Rolfe*, 130.
Phellodendron, 231.
Philpott, G. T., 136.
Phlomis spectabilis, 374.
Phormium tenax in Falkland Islands, 378.
Phyllanthus asperulatus, *Hutchinson*, 27.
— delagoensis, *Hutchinson*, 28.
— inflatus, *Hutchinson*, 334.
Phyllostachys aurea, flowering of (with figs.), 217.
Pines at Bicton, 269.
Plagiorhegma and Jeffersonia (with figs.), 242.
Pleurothallis grandis, 373.
— punctulata, 287.
Podophyllum Emodi, var. chinense, 287.
Polypodiopsis, 372.
Polystachya natalensis, *Rolfe*, 129.
Pomology, Journal of, 77.
Port Elizabeth and Uitenhage, Flora of, 139.
Powell, H., 220.
Primula pulvinata, 287.
— spicata, 255.
Pseuderanthemum Dawei, *Turrill*, 69.
— ellipticum, *Turrill*, 69.
Psychotria aborensis, *Dunn*, 133.
— Barberi, *Gamble*, 248.
— globicephala, *Gamble*, 249.

Q.

Quercus Aegilops, 100.
— alnifolia, 122.
— coccifera, var. palaestina (with plate), 257.
— cleistocarpa, 123.

R.

Reid, J., 286, 377.
Rhinacanthus grandiflorus, *Dunn*, 135.
Rhododendron hippophaeoides, 123.
— ledoides, 287.
— lutescens, 287.
— Sargentianum, 374.
— serotinum, 287.
— strigillosum, 374.
— vernicosum, 287.
Ribes Jessoniae, 287.
— niveum, 287.
Rogers, F. M., 286.
Rosa glutinosa, var. dalmatica, 255.
Rosmarinus, the genus (with figs.), 105.
— officinalis, var. genuina, *Turrill*, 105.
Rubus Burkillii, *Rolfe*, 109.
— Chambica, *Rolfe*, 132.
Ruck, E. A., 368.

S.

Sabia latifolia, 373.
Sadiria Poweri, *Dunn*, 111.
Salvia brevilabra, 287.
Sapindus trifoliata or S. laurifolia, 250.
Schonland, S., a trip to the Knysna, 225.
Science and Fruit Growing, 77.
Sclerotium Rolfsii, 321.
Semiaquilegia, revision of, 165.
— Eastwoodiae, *Drummond et Hutchinson*, 165.
— Henryi, *Drummond et Hutchinson* (with fig.), 166.
— simulatrix, *Drummond et Hutchinson*, 166.

Senecio Lawsoni, *Gamble*, 342.
— Snowdenii, *Hutchinson*, 24.
Sesbania sericea as a green manure crop (with figs.), 252.
Setaria or Chaetochloa? 124.
Shrubs, new or rare, 119.
Siam, Flora of, 300.
Sindian, botanical history of, 258.
Small, W., 367.
— —, a wilt of carnations, etc., 321.
Smilax megalantha, 124.
Smithiella, *Dunn*, gen. nov., 210.
— myriantha, *Dunn* (with figs.), 211.
Souliea vaginata (with fig.), 167.
South African Aloes, 138.
— — Flowering Plants, 374.
Spruces at Bicton, 271.
Stanhopea costaricensis, 287.
Stellaria or Alsine, 308.
— Wallichiana, *Haines*, 66.
Stemona Collinsae, *Craib*, 305.
Stigmatostalix costaricensis, 255.
Stranvaesia salicifolia, 373.
Strobilanthes aborensis, *Dunn*, 208.
— Burkilli, *Dunn*, 208.
— tenax, *Dunn*, 209.
Styrax casearifolia, *Craib*, 304.
Sweden, Flora of, 74.
Symphyandra asiatica, 287.
Symplocos Kerrii, *Craib*, 304.
Syringa reflexa, 374.

T.

Taiwania cryptomerioides, 72.
Tetrastigma alcicorne, *Haines*, 67.
Thellungia, *Stapf*, gen. nov. (with figs.), 96.
— advena, *Stapf* (with figs.), 98.
Thesium brachystylum, *A. W. Hill*, 176.
— fimbriatum, 176.
Thorncroftia longifolia, 255.
Thunbergia prostrata, *Turrill*, 25.
Toppin, Major S. M., notes on the Balsams of Chitral and the Kachin Hills (with figs.), 345.
Tozer, H. F., and his collections, 29.
Trachelospermum anceps, *Dunn et R. Williams*, 343.
Trail, Prof. J. W. H., 32.
Trees, new or rare, 119.
Tresco Abbey gardens, 170.
Tropical Africa, Flora of, 373.
— agricultural college in the West Indies, 81.
Tupistra veratrifolia, *Kurz ex Dunn*, 344.
Tutcher, W. J., 136.
Tyson, W., 176.

U.

Uganda fungi, notes on, 289.
Uitenhage and Port Elizabeth, Flora of, 139.
United States, economic woods of, 75.
Upsala, old Linnean garden at, 221.

V.

Vardy, M., 71.
Vatica Shingkeng, *Dunn*, 108.
Venidium macrocephalum, 287.
Verbascum Blattaria, var. grandiflorum, 374.
Vernonia anamallica, *Beddome ex Gamble*, 339.
— Bourdillonii, *Gamble*, 339.
— gossypina, *Gamble*, 340.
— Heynei, *Beddome ex Gamble*, 340.
— multibracteata, *Gamble*, 340.
— pulneyensis, *Gamble*, 341.
— shevarovensis, *Gamble*, 341.
Veronica Chamaedrys, var. rigida, *Turrill*, 192.
Viburnum Garrettii, *Craib*, 302.
Vitex Pooara, *Corbishley*, 333.

W.

West African oil palm, 199.
— — — —, diseases of (with plate), 306.
— Indies, tropical agricultural college in, 81.
Wheat in East Africa, 78.
Wickham, Major R. T., 219.
—, Sir H. A., 175.
Wilson, Dr. J. H., 71.
Wortley, E. J., 285.

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